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THE
NATURE-STUDY REVIEW

DEVOTED PRIMARILY TO ALL SCIENTIFIC STUDIES OF NATURE IN ELEMENTARY SCHOOLS

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VOL. 9 JANUARY, 1913. NO. 1

Meeting of American Nature Study Society

The Cleveland meeting of the American Nature-Study Society was held in conjunction with that of the American Garden Association. The program was carried out as printed and in addition, a number of papers were presented on various phases of the garden work.

The officers elected for the ensuing year are as follows:

For President: Anna B. Comstock.

For Vice-Presidents: E. B. Babcock, California; M. A. Bigelow, New York; Otis W. Caldwell, Illinois; Stanley Coulter, Indiana; B. M. Davis, Ohio.

For Directors: E. E. Balcomb, North Carolina; Ora M. Carrel, Michigan; Anna Clark, New York; Gene Patterson, Illinois; Susan B. Seipp, D. C.

For Secretary-Editor: Elliot R. Downing, Illinois.

Instead of presenting any abstracts of the papers and discussions, the President's address is printed in full. We sincerely hope the custom that President Davis has initiated may be established as a permanent custom, and all who read his address, as well as all who heard it, will appreciate the work involved and the value of his results.

The following items from the report of the Secretary-Editor may be of general interest:

Receipts from subscriptions, reprints, etc., $1,187.91; preceding year, $1,122.64.

Expense of printing, $1,132.17; preceding year $677.20.

In spite of the increased expense the balance forwarded to 1913 is nearly as great as that carried over a year ago.

New subscriptions, September-December, 274.

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Summary of a Study of Instruction in Agriculture in Rural Elementary Schools[1]

B. M. DAVIS,

Miami University.

As member of the Committee on "Course of Study in Agriculture for Rural Elementary and Secondary Schools" appointed by the Department of Rural and Agricultural Education of the National Education Association, I undertook to prepare that part of the report relating to elementary schools.

An examination of the literature of the subject left me much in doubt as to what would best serve the average school under average conditions. Many of the published courses of study examined were apparently based upon what was considered desirable rather than upon what might be reasonably expected. Several questions arose that seemed important to answer before much progress could be made toward outlining a course of study, and to which no satisfactory answers could be found in the various publications consulted. I therefore decided to go to the original sources—to the teachers themselves, who were having successful experience in teaching agriculture in the rural schools, and to others who were especially interested in the problems of rural education.

Through correspondence with state and county departments of education, with agricultural colleges and state normal schools, and from other sources a selected list of about eight hundred names was obtained. From this list five hundred were chosen, according to geographical location, and to each the following questionaire was sent:

1. Do you regard it desirable to cover the whole subject of agriculture in an elementary way with pupils below high school?
2. Or do you regard the plan of selecting certain units or topics such as corn, milk, poultry, plant enemies, etc., more desirable.
3. Give list of topics or units that you have found or regard as most successful.
4. Is home-made or school-made apparatus used? If so, give examples of some used to best advantage.
5. To what extent has outdoor field work been used successfully? State nature of the work (subjects), and approximately the amount of time spent.

[1]Address of President, Annual Meeting of American Nature-Study Society, December 30, 1912.

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6. To what extent have farm animals been used in teaching, *i. e.*, actual study of the animals themselves.
7. How did you manage this animal study?
8. How much experimental work on school grounds or in building have you done?
9. How was this experimental work managed?
10. To what extent have you made use of borrowed apparatus such as farm machinery, scales, milk-testers, etc.?
11. To what extent has the work in agriculture been a practical success judged by application at home, and in approval of patrons?
12. In what ways has agriculture been correlated with other school subjects?
13. Has it helped instruction in these subjects?
14. Mention some difficulties you have met with in the teaching of agriculture.
15. What has been your guide in selection of topics or units for instruction, *i. e.*, teachers' manual, textbook, community interests, etc.
16. Will you suggest on back of this sheet some things that should be included in a course of and study that would be most helpful to a teacher?

It will be seen that the questions submitted cover six factors which should be taken into consideration in planning a course of study intended to help standardize instruction in agriculture in rural elementary schools. These factors are as follows: (1) Subject matter (1-3); (2) ways and means (4-10); (3) reaction on the community (11); (4) relation to other school subjects (12-13); (5) difficulties (14); (6) basis of selection of topics now being taught (15).

One hundred and seventy-two replies were received. Most of them were very complete, often accompanied by much additional information. They showed interest and experience, and a faith in the possibilities of agriculture as a rural school subject. Thirty states were represented, including all sections of the country from Maine to California, from Minnesota to Texas.

I shall attempt in this paper to give a brief summary of the data obtained, and to present representative comments selected from responses to the questionaire.

Elementary instruction in agriculture is given in two ways, one in which the whole subject is covered, the other in which only certain phases or units are considered. It is desirable to determine which of these ways is the better; especially if any attempt to standardize instruction is to be made. The first two questions were meant to secure an expression from teachers on this point. Of the one hundred and fifty-five answers to these questions fifty-seven favored covering the entire subject, while ninety-eight preferred to confine instruction to certain units.

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The answers to the third question, however, showed that many of these fifty-seven teachers found some topics more successful than others. In order to determine whether the answers were colored by local conditions a tabulation of answers from the leading agricultural states was made. The result showed approximately the same ratio. This ratio holds for states requiring instruction in agriculture as well as for those that do not. The following are some typical answers representing both points of view:

"I should question giving much time to study of animal husbandry or anything that would not tend to vitalize the other subjects in the curriculum."

"A compromise of Plans 1 and 2 would be most desirable."

"I think only the simplest forms of agriculture can be satisfactorily taught in grammar school."

"Yes, with the exception of some technical subjects. Nature-study organized so as to present phases all through the grades would take care of much of it. If handled properly, any important agricultural subject may be presented intelligently in its essentials to grade pupils."

"Make it as complete as possible, yet elementary. So many of our pupils never see a high school. They need more than a mere smattering."

"I think it is all right if there is sufficient time. But I find that in a school with from forty to fifty pupils certain topics are more profitably used, such as live-stock, corn, wheat, sugar cane, etc."

"I believe to treat in an elementary way would be more profitable as the pupil does not know what he is best fitted for at this age, and the wider the scope the better the chance for the pupil."

"I do not think so, because the subject is too extensive, neither is it practicable or practically useful."

"I think certain topics like those suggested in question No. 2 should form the course of study, but it would be well to have the pupils read some book or books that cover the whole subject."

"Depends upon the number later attending rural high schools with courses in agriculture, and degree of specialization. Danger in repetition causing some bad results already seen in physiology."

"I think type studies will have to be developed for both the elementary school and those high schools that can give only one or two years work."

"No, I do not; I believe the average pupil will gain more when certain units are emphasized."

"No, I do not for the reason that the minor and more important facts are slighted on the work."

The third question was intended to determine what units were regarded as the most successful. Nearly all phases of agriculture are represented in the lists of topics given in the answers. The following topics are mentioned in order of frequency in answers: field crops, including corn, wheat, potatoes, alfalfa, clover, bar-

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ley, oats, vetches, peas, cotton, sweet potatoes, sugar cane, and tobacco; farm animals, including horses, hogs, sheep, and including also stock judging and rations; dairying, including Babcock test, care of milk, and rations; soils, including drainage, dry farming, irrigation, and texture; insect enemies; poultry; horticulture, including budding, grafting, spraying, and pruning; gardening, including school gardens, plot experiments, and growing contests; weeds; seed testing, including selection, germination tests, and purity tests; birds; plant studies, including a variety of phases; flowers; plant propagation; farm management, referring especially to farm accounts; fertilizers; farm machinery; roads; bee-keeping; weather; farm buildings; plant breeding; marketing. Most of the topics suggested were confined to the first half of the list. The great agricultural interests—field crops, especially corn and wheat, farm animals, dairying, and soils were mentioned far more frequently than any other topics. The answers clearly indicate that the phases of agriculture meeting with the greatest success in teaching were closely correlated with dominant local farm interests. A few quotations will illustrate the character of the work done by teachers reporting:

"All truck plants, fruit and nuts that are grown in this region only. Farm animals, some insects and soils."

"This is a forest region and we have given the intensive study to timber production: (1) nuts, (2) enemies, (3) nurseries, (4) methods of reforestration, (5) age of trees, (6) harvest, (7) ranger method, (8) fire fighting."

"Corn testing, selection for seed, storing seed. Milk, the Babcock test, care of milk. Weeds common to the vicinity, names of seeds, how to destroy. Poultry, right kind of poultry houses, care of chickens, marketing. Soil, principally in relation to drainage and maintaining fertility."

"The topics I have found most successful are (1) study of corn from time seed is chosen to the finished products made from corn. Corn happens to be the main product of this part of the country. It might be some other product elsewhere. (2) Animal husbandry. (3) Rotation of crops, treatment of soils. In the lower grades garden, flowers and birds."

"Have not done much except in animal study except the study of the general purpose animal (horse). Been most successful along the line of soil study, plant food, legumes, regulation of soil moisture, forestry and landscape."

"We are going to try poultry raising because the children derive a financial benefit from it quicker than any other line."

"The subject of cotton, corn, peas, vetches, and clover are of the most benefit to this section."

"This is a horticultural region. Soil, pruning of trees and bushes as well as planting them. Budding, grafting and spraying.

"Each child has his own plot for vegetable and flower growing.

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Sells vegetables and keeps the money. Class experiments show osmosis, conservation of soil moisture, etc."

Probably most of the instruction in agriculture in the rural schools has been by text-book with little or no illustrative material. This practice is defended on the ground that it is too difficult in the average school to secure facilities for any other kind of instruction. The second group of questions (4-10) refer to methods used by successful teachers to present the subject concretely by dealing directly with the material upon which the subject matter is based. That such a procedure is feasible is indicated in the answers to questions of this group.

The problem of apparatus necessary to perform simple experiments was solved by teachers in various ways. Very little purchased apparatus is possible in the rural school even if it were desirable. One teacher says: "I believe if the pupil can make his own apparatus, much of the unnatural coloring is eliminated from his results. He is likely to be influenced unduly by the fact that he is using a fine piece of apparatus and unconsciously feels that somehow a large portion of the results come from the apparatus rather than from operation of the natural law which is being investigated." Forty-two of the one hundred and forty-six teachers responding to this question (4) used home-made apparatus, sixty used school-made, thirty-nine used both, and five used some purchased. The use of home-made apparatus seems to have had two advantages, one in saving school time, the other in carrying school interests into the home. The school-made apparatus brought more children in contact with the work, and gave the pupils the benefit of the teacher's suggestions. A few of the answers will be of interest:

"Both should be used. In this connection we have constructed an unusually successful "go-devil" for diking land for irrigation, drawing plans in school and having the boys construct the machine in the home shop. Hot beds and cold frames have been built and used in the school.

"Home-made, mostly, except the Babcock test, for which we use a small portable outfit. Home-made saw-dust seed corn tester. Home-made apparatus for soil experiments; models of chicken houses, silos, barns, etc."

"In all cases when possible I use home-made apparatus—e. g. illustrating tile draining, irrigation. Pupils make necessary apparatus."

"Both are used: Corn tree; corn germinating box; model chicken house; soil and sand table, on which is fastened a top to be used for various purposes, as holding a milk tester, seeds, etc.; milk cabinet, as a model to be used in barn to hold records, etc."

"Home-made corn tester, brooder, nest builder."

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"Home-made apparatus. Corn tree for curing corn, corn testers. We add five per cent to standing in agriculture if pupil has made and used apparatus at home."

Agriculture deals with growing things. Field study, in which pupils may learn of these things, first-hand—by direct observation—is quite as important as is apparatus to demonstrate certain principles of agricultural science. In spite of the difficulties of this kind of teaching in the rural schools the successful teacher manages somehow to make more or less use of this method. Of the 142 teachers replying to this question (5), 131 did some field work ranging from a few hours in the spring months to five hours a week during the school year. Many used the time before school opened or after school closed, or recess and noon periods. The following are some methods used:

"The element of time is our gravest problem as the enthusiasm is so great that we could work out most any scheme 'if we had time.' We have one-half hour per week regularly for gardening, but many noon and recess hours are gladly—voluntarily given.. We have so far not found time for other outside lessons."

"Have made the garden the unifying center for agricultural nature-study. Birds, insects, etc., have been studied as they touched the lives of the children. Two hours a week."

"Very few school excursions were taken. Most of the pupils lived on farms, and by aid of some of the parents we were able to complete what we undertook."

"The greatest part of the work is done at home through the enthusiastic leadership of the schools. Home gardens, acre yield of corn, potato growing, dragging roads, etc."

"Excursions are frequently made to some nearby field or fields to study the soil, effect of moisture, manures and heat upon the plant and soil, harvesting and condition of plants."

Another phase of agricultural instruction that teachers often find difficult to handle is animal husbandry. Yet farm animals stood second in the list of topics reported upon as being successfully taught. Of the ninety-nine teachers who made use of this subject in their schools, seventy-one indicated how they did it: sixteen at school having animals brought there, twenty-nine by having the children make certain studies at home and reporting at school, twenty-six through demonstrations by teachers at various farms, nineteen by means of pictures and reading to be verified at home, and two by demonstrations at fairs. The details of some of the methods used are as follows:

"After a suitable introduction the class is taken to the animal or the animal to the class, just as seemed handiest."

"All the home animals are judged and tested."

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"Points are discussed in class—then pupils are taken to nearby farms and animals judged."

"Last term we studied the cow, the different build of the dairy and beef cow, etc. We also studied and took particular notice of the different types of horses, hogs, etc. This proved to be a very valuable study."

"Special animals of different breeds were studied. Then as often as we could get conveyances we visited neighboring farms and then compared the stock found with the ideals formed in the mind. First studied the ideal form for the animal in the different classes, as beef, dairy; draft and roadster; lard and bacon; mutton and wool. Then started to find an example of that ideal (usually failed) but always succeeded in showing the possibilities of improvement by careful breeding."

"Dairy cows have been used for demonstration purposes. These were brought to the class on the school premises. The study with the actual animals was mostly concerned with conformation to the dairy type."

"I had the animals brought to the school yard, visited with the class at stock farms and required home studies of such studies on home animals."

"Parents have furnished the animals providing school boys deliver them both ways and feed and water them while being used."

"We have judged cattle by the score card sent out by the extension department of the university; also, when possible county fairs were visited by the class here."

"Studied animals belonging to school patrons using judging blanks, then writing up defects, blemishes, good points, etc., and comparing various animals."

"The pupils were taken to farms having best herds. Here regular stock judging on farms is done."

One hundred and thirty-five made definite reports of use of experiments in their teaching. Some conducted the work in the school house, some on the school grounds or in school garden plots, and others by having experiments done by the pupils at home and results reported at school. Various plans were used, for example:

"Different simple experiments were assigned to different pupils who worked them out and showed results to the class. One class instead of raising vegetables assumed the duty of covering an unsightly fence with sweet peas; in addition to studying up the nature of the soil, etc., they tested the seed before planting and determined the per cent germinating. Also valuable experiments in different methods of irrigation."

"As a class demonstration and laboratory work on the part of the pupils. They glory in it. Eggs are regularly brought to the class for fertility testing before incubation."

"Permitted the entire school to participate during such periods. They were done during regular school hours."

"In my work I allowed the children to tabulate operations and results, but children could do it as well and with probably better after results."

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"Corn was tested in large quantities—boxes filled with different kinds of soil used to test different seeds, germination, the effect of moisture, etc."

"The work was managed by both the pupils and the teacher in co-operation. One pupil would be given a certain experiment to perform and another pupil or group of pupils would be given another."

"Dividing the school into three or four classes and allowing time each week to each class and when possible give each a plot of ground to care for and study. When with this class, others are left to do their own work."

"Teacher illustrates the process and then asks pupils to perform similar operation with different materials. Their work is for most part done at home."

"I appoint committees or certain pupils to do certain definite work. They are held responsible, and are expected to report at different times regarding their work."

In making an estimate of the success of agriculture as a school subject patrons as well as pupils should be considered. Unless results reach beyond the school into the home its place in the curriculum can hardly be justified. All but four teachers responding to this question (11) regarded their work in agriculture as successful in this respect.

"One boy increased daily yield of milk about one-half in family cow by adopting feeding standard—great enthusiasm. Others tried other animals with varying success. Gardens at home and decoration of home grounds are carried on by pupils to the extent of perhaps 75 per cent."

"One of my patrons whose home has never had any care and where there has never been any attempt at cultivating the yard, has made a flower bed along the front of the yard, and has planted out other flowers. They are now talking of fixing the house as soon as they can."

"To a gratifying degree. Special crops are tried out in many instances; rations for dairy, brood and draft animals are in use; modified irrigation is being permitted for boys on their own tracts, and remedies for animal diseases have won favor with the patrons."

"In one instance the farms at home were treated with lime as a result of the lime experiment on acid soils at school. Flowers were grown and cared for more intelligently."

"By pupils planting experiment fields of their own and trying to raise crops that are not raised here; such as cotton, tobacco. By pupils grafting and budding different fruit trees."

"Patrons have been extremely well satisfied. They help in every way posssible. In several cases tests have been made which disprove old theories held for years."

"It has interested boys in school that were never interested before and the parents think it is grand."

"Japanese plum trees set in connection with school. This has been the direct cause of setting at least five hundred in the neighborhood and the end is not yet. Pure bred Leghorn chickens have been introduced. Also alsike clover, deeper tillage, home mixing of fertilizers, etc."

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"There are many instances of methods being changed by the fathers of children studying elementary agriculture in schools, such as undertaking to spray trees, changing methods of plowing, beginning to test cows and keep milk records, testing seed corn and other farm seeds, etc."

"Very much. In a great many cases farmers have entirely changed their methods of farming. All the boys, and some girls have a garden plat of their own and have entire control of it. In the fall we have a garden contest, an exhibit in school where parents gather to inspect. The products are judged and prizes given."

"The patrons are all greatly interested in all our work, and approve of it. I notice the farmers are all testing their seeds after the manner we test it in school."

"The seed testing this spring awoke a real interest and resulted in the purchase of hundreds of bushels of tested seed corn. This will be a poor corn year in Wisconsin when seed was not tested."

Correlation of other subjects with agriculture may have a two-fold value, one in economy of time, the other in giving a practical turn to these subjects—especially to the formal studies such as arithmetic. All but one teacher found that instruction in other subjects was helped by correlation with agriculture. Arithmetic, language and geography were generally specified. History, reading, nature-study, manual training, domestic science, drawing, and physiology were also mentioned. The following are some of the answers to questions 12 and 13:

"The use of topics for language lessons, with geography and some arithmetic. This subject, agriculture, gives them something definite, something practical and interesting to work with."

"I believe agriculture should be a separate subject in the upper grades and not a 'correlated kink' to other subjects. However very good correlation with arithmetic, geography, history and manual training is possible."

"In arithmetic a study of the silo—lateral surface, foundation, conents and application of the cylinder. Language, geography, and reading."

"In arithmetic it can always provide actual data for practical problems. In geography it is rich in earth facts. In language it furnishes experiences to be expressed. In history it has helped make the present civilization possible. I have found agriculture or nature-study very helpful, especially in teaching home geography, language, composition, and arithmetic."

"In arithmetic through farm problems. In language through compositions on farm subjects. In geography by consideration of products and physical conditions. Reading supplemental in farm bulletins."

"In geography, the subject of soils, climate, native and local vegetation. In history, the introduction of tobacco, wheat, sugar, corn, etc., into United States. How, when, and where the growth of each; annual output of each. It has made these subjects far more interesting."

"With geography for location of thorough bred horses and cattle. With grammar and composition work. With arithmetic for farm computations."

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"I find that problems in arithmetic are being used that are of practical value; good product maps, etc., in geography; reading connected with the study of birds; food products, and charts connected with the study of physiology."

"Taught farm problems in connection with arithmetic. Made interesting subjects the basis of composition work. Prepared industrial, county and township maps."

"A practical use made of the methods and materials of any subject at once raises the value of that work in the pupil's estimation."

"It has. It makes them ask what the cube root is good for in the 8th grade."

"It certainly has added new interest in subjects, therefore showing the necessity of other subjects."

"It has not only helped instruction, but made the other subjects more interesting to pupils."

"As we regard it an integral part of the instruction this question is much like asking does it help arithmetic to use figures."

"It has brought far off things back to the pupils' own experiences."

Although the teachers who responded to the questionaire have been succeeding well in teaching agriculture they have met various difficulties. Most of these difficulties, however, are common to all subjects of instruction in rural schools. Among those mentioned were lack of time, too many grades, too few books, too little material and apparatus, adverse attitude of patrons, course of study, long vacations interfering with garden and plot work, lack of preparation on part of teachers. A few examples will illustrate the difficulties as seen by the teachers themselves:

"One of the most serious problems to be solved in connection with successful agricultural teaching is that of obtaining conditions which approach somewhat the conditions actually encountered on a real farm. Many more important operations must be left for the pupil to obtain at home, before and after school. Many parents will not take the time to make operations valuable and interesting to the boys."

"Lack of apparatus, knowledge on the part of the teacher as to the essential topics to teach, etc."

"Lack of time; no former teaching of the subject; no suitable text. Prejudice against the subject by not only parents but some teachers; the farmer's argument of "a book farmer."

"None, only I have not time sufficient to get the most out of it. What I have done is on borrowed time from recesses and noons."

"Opposition of our teachers in the system. Pupils always become enthusiastic, and then occasionally some of the teaching force becomes jealous of the success. Lack of time under present course of study caused some difficulties."

"The greatest difficulties are in overcoming old prejudices which have been handed down from father and son for generations."

"Lack of time; school houses not being warm enough in winter to prevent freezing the plants started in the fall."

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"The lack of good apparatus and a convenient school house for such work are some of the difficulties which I have met in my teaching agriculture."

"Lack of time to apply to the work; insufficient apparatus; lack of suitable texts; school closes too early to do the amount of outside work that should be done; hired for but for the school year."

"Lack of good types of stock; lack of real interest on the part of the farmers."

"Lack of time according to our own course of study; much of our work must be done after school hours, but have no difficulty with complaints from patrons for so doing."

"The pupils take great interest in it, but unless it is disguised under the head of language, etc., the parents are much against it."

"Lack of time to give to it and to the practical work in it as we would like to do owing to the demand of our high schools that our pupils be well grounded in true discount, bank discount which, if they were better prepared to earn a living, they would have little demand for in after life."

"My own lack of special training. The lack of good text-books. The fact that there is no definite syllabus in elementary agriculture."

"Never had any. Everybody likes it. Can't get time enough."

"Lack of agricultural sentiment in the community; lack of text and reference books for the pupils. School in session at the time of year when practical work cannot be done."

"Our teachers are high school graduates who do not know the difference between a silo, whether a silo is a machine or kind of sheep, and our greatest difficulty is teaching them, and putting them into the right attitude."

"The principal one is that each part of the country presents different problems and it is hard to be posted on the needs of different parts when you change so often."

In the selection of topic or units for instruction, most teachers were guided by local or community interests, some followed the text-book, others a course of study prepared by state or county departments of education.

While getting the experiences of so many teachers who were actually engaged in teaching agriculture in the rural elementary schools it seemed desirable to get an expression from them regarding a course of study in agriculture. They were asked to indicate what would be most helpful to them. Many valuable suggestions were made in response to this question, among them: arrangement of subjects in the order which they should be taught, a summary and explanation of experiments to be performed, some scheme to meet local needs, some definite statement of correlation with other subjects, means of securing illustrative material, and sources of information on various topics.

Although this summary includes responses from less than two hundred teachers it is representative of the most successful

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agricultural teaching in rural schools extending over a wide range of territory, and under a great variety of conditions. The testimony of the teachers themselves is the best indication of the possibilities as well as of the limitations of the subject in the average school. It will be a long time before centralization of rural schools will become general. In the meantime every means should be employed to make the existing schools more efficient. Teachers in these schools need all the help and encouragement they can get. They need to see the teaching possibilities, even under adverse conditions, of country-life subjects, and to appreciate the value of such teaching not only in relation of the school to the community but also in its reaction on other subjects. This summary is presented in advance of a more complete discussion of agricultural instruction in rural schools, to be published later, with the hope that some teachers may be encouraged by seeing what is now being done by others in the same class of schools under similar conditions to introduce this kind of teaching.

Tree Study in Winter

A. F. BLAKESLEE.

FIRST PAPER.

Most students begin their acquaintance with trees in summer and use leaves as the earmarks of identification. The forester and lumberman, however, are more called upon to distinguish trees in winter when leaves and flowers are fallen than in summer. Trees, as the most conspicuous elements in the winter landscape, must also appeal to the student of out-door life. The interest shown by classes of school teachers in the Summer School in identifying specimens of twigs collected the previous winter indicated to the writer that the winter study of trees can be taken up with enthusiasm by teachers in their schools. Those who have reported trying the work have met with success. In our experience, the winter identification of trees has proven to students one of the most interesting subjects of their course. It is of decided value for its training in the power of accurate observation. The work comes at a time when material for natural history study seems scanty and might therefore be used to bridge over the period between fall and spring which are unfortunately considered by many the only seasons when study of out-door life is possible in the schools. A tree in winter is far from being

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FIGURE 1.—White Elm.

the characterless object many believe. Freed from its covering of leaves, the skeleton of the tree is revealed and with the method of branching thus clearly discernible, the species may generally be more readily identified at a distance than in its summer garb. There are many forms, moreover, that are difficult to distinguish from summer features alone but which in winter have twig, bud or other characters which make their separation comparatively easy.

In the present brief article only the identificational side of

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FIGURE 2.—Carolina Poplar.

winter tree study can be taken up and a few of the winter marks of distinction suggested. The aim toward which this type of study should tend is the ability to recognize a tree at a distance by the general "habit" of growth or by bark characters. Habit and bark characters, however, are difficult of precise description, and markings on the twigs must be used as a means of identification in the early stages of our knowledge. In the following paragraphs some of the identificational characters of value will be discussed under the proper headings.

Habit—By the word habit, we denote the general appearance of a tree seen as a whole. A tree strictly speaking is generally considered as a woody growth having an undivided trunk at the base and rising to at least twice the height of a man. A shrub on the other hand is low-growing and may branch from the very base. No hard and fast line, however, can be drawn between a tree and a shrub. Many trees at the limit of their range or under unfavorable conditions are reduced to the form and dimensions of a shrub and some forms growing as shrubs in New England become trees in states outside this group.

Two general habit types are recognized—the spreading and the erect—often termed deliquescent and excurrent, respectively. The former is well represented by the Apple and White Elm (Fig. 1)* and the latter by the Evergreens and those of the Poplars that form narrow conical heads (Fig. 2). By its more erect habit of growth the Sweet Cherry is readily distinguished from the

*NOTE.—That illustrations are from Bulletin 69, New England Trees in Winter, Storrs Experiment Station, Storrs, Conn.

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Sour Cherry and in like manner the Pear from the Apple. It is these habit differences that form the most ready means of separating the contrasted trees just mentioned which may closely resemble each other in twig characters. The angle which the branches make with the trunk is frequently a diagnostic character of considerable value. For example, the ascending and gracefully outward curving limbs of the American White Elm stand in contrast with the sharply divergent limbs of the English Elm. Likewise the horizontal branches of the Tupelo and the strongly pendant lower limbs of the Swamp White Oak are characteristic of these species. The relative thickness of the branchlets contrasted in the Sweet Cherry and the Black Birch and the arrangement of the branchlets whether opposite or alternate and whether erect or drooping, may further be mentioned as habit characters.

The method of branching and other features included in the habit do not furnish such precise marks as do the twigs, and cannot, therefore, be of much value in a descriptive key. In fact, the habit varies considerably among individual trees of the same species, no two trees having exactly the same method of branching. Moreover trees grown in woods in company with other trees are prevented by lateral shading from developing their normal form and produce tall trunks with but little branching. The age of the tree is also an important factor in the outline, young specimens being in general narrower and more conical than in later life while those in old age may have lost shape through ice storms, high winds and the attacks of fungi. Trees grown in the open, however, despite the vicissitudes to which they may be subjected, tend to assume a characteristic appearance.

As one becomes more familiar with trees in their winter aspect, the number that cannot be recognized at a distance becomes greatly diminished. We come to know trees by hardly definable traits, much as we recognize our friends at a distance by some peculiarity of form or gait. Watching the trees from a car window is a great help in acquiring this familiarity with the habit characters.

Bark—Although it is upon the appearance of the bark more than upon any other character that the woodsman depends in his recognition of timber trees, the bark shares with the habit the misfortune of being difficult of precise description. A study of photographs, however, in connection with descriptions of the color and texture will enable one to recognize a large proportion of our trees by the appearance of the bark alone.

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FIGURE 3.—Yellow Birch.

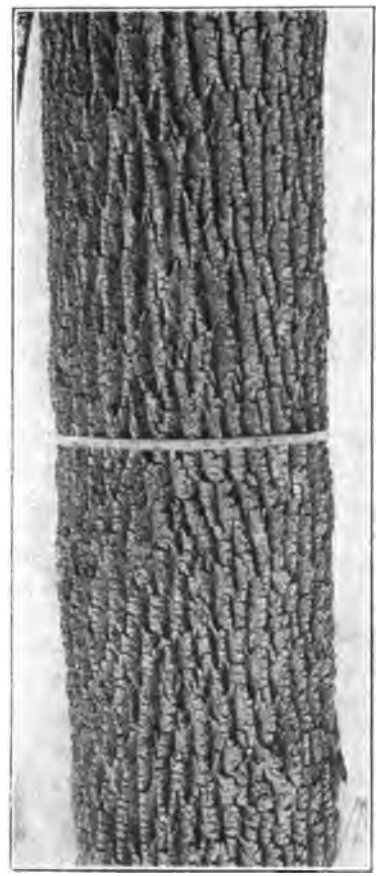

FIGURE 4.—White Ash.

The color of the outer bark is an important mark of distinction and is the chief means of separating the different species of the Birches. The color and taste of the inner layers of the bark are in some cases also characteristic. The Black Oak, for example, is best distinguished from other Oaks by the yellow and intensely bitter inner bark. Similarly, the Black Birch, the Sassafras and the genus Prunus, including the Cherries, have barks with characteristic flavors. The swamp-loving Poison Sumach is the only poisonous tree in New England so that after this shrubby form is known there need be no fear of tasting bark and twigs of any unknown tree-like species.

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The bark varies in character according to the age of the tree. In the young tree it is smooth, but, as the trunk expands from the growth of the wood within, the covering of dead bark outside is forced to crack in a variety of ways, giving rise to characteristic fissures and ridges which become more prominent as the tree grows older. The bark of few trees such as the Beech and the American Hornbeam remain smooth, their outer layers expanding with the growth of the tree. The barks of others as the Yellow Birch (Fig. 3) stretch and peel off in thin papery layers. In the Birches and Cherries the breathing pores (lenticels) become horizontally elongated to form narrow transverse streaks which are characteristic for these forms. When ridges or scales are formed they may be close and firm and with difficulty removed from the trunk as is the case with the bark in the Black Oak group or, on the other hand, they may be easily rubbed off as are the scales of the bark of the White Oak and of most members of the White Oak group. Bark of this latter type is called *flaky* and this distinction between barks that are flaky and those that are not flaky is of considerable importance in classification. The bark may come off in large sheets as in the Shag-bark Hickory and the Sycamore, and the ridges may be long as in the Chestnut or short and run together to form more or less perfect diamond-shaped areas as in the White Ash (Fig. 4).

Twigs—The Horse-chestnut (Fig. 5) may be taken as a convenient form to illustrate the various markings found on the twig. The large triangular patches resembling somewhat closed horse-shoes in shape are the *leaf-scars* showing where the bases of the leaf-stalks were attached to the twig before their fall. The little dots corresponding to the nail holes in a horse-shoe are the *bundle-scars* and mark the location of the so-called fibro-vascular bundles. The leaf-scars are located at the *nodes* and the portion between the nodes is called the *internode*. Scattered along the twig are little dots, the *lenticels*, which are openings that function to a certain extent like breathing pores. Above each leaf-scar is normally produced an *axillary bud*. The *lateral buds* are in distinction to the *terminal buds* at the ends of the twigs. The *bud-scales* at falling leave a ring or band of *scale-scars* marking the limit of each year's growth. These bands often remain distinct for many years and by counting their number the age of the branchlet may be estimated. Thus it can be readily seen that the figure of the Horse-chestnut represents growth made during three years.

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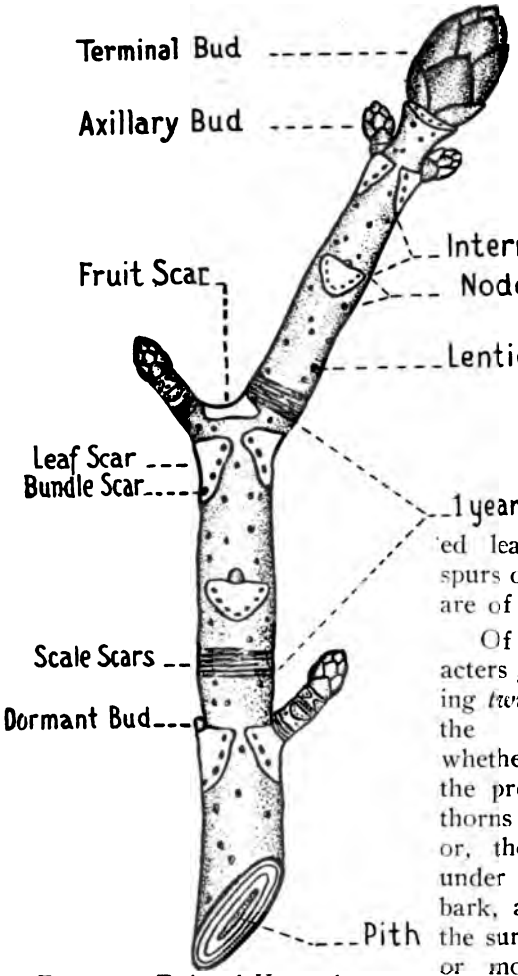

FIGURE 5.—Twig of Horse-chestnut.

In some species, such as the cultivated Cherry, a sharp distinction can be drawn between rapidly-grown long shoots which have elongated internodes and continue the growth of the twig and slowly grown short spurs which have greatly abbreviated internodes and crowded leaf-scars. The fruit-spurs of the Apple and Pear are of this latter type.

Of the distinctive characters given under the heading *twigs* may be mentioned the relative thickness, whether stout or slender, the presence or absence of thorns or prickles, the color, the taste as indicated under the discussion of the bark, and the character of the surface, whether smooth or more or less covered with hairs. The color, size and shape of the pith are often characteristic as seen in the wide salmon-colored pith of the Kentucky Coffee Tree and the star-shaped pith of the Oaks. Some few trees have their pith separated by hollow chambers such as the Butternut.

Leaf-scars—The arrangement of the leaf-scars form primary divisions in the classification. They may be *opposite* with two scars at a node as in the Horse-chestnut, or *alternate* with only one scar at the node as in the majority of species. Alternate leaf-

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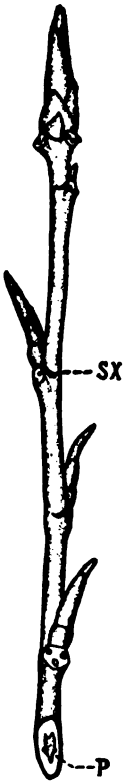

FIGURE 6.—Twig of Carolina Poplar. sx—Stipule Scar. p—Star-shaped Pith.

FIGURE 7.—Twig of Butternut. tr—terminal bud. ax—axillary bud. sp—superposed accessory bud. p—cnambered pith.

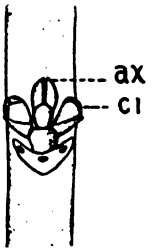

FIGURE 8.—Twig of Red Maple. ax—axillary bud. cl—collateral accessory bud.

FIGURE 9.—Twig of Mulberry. ax—last axillary bud often mistaken for a terminal bud. sc—self-pruning scar left by fall of real terminal bud and tip of twig.

scars may be arranged along the twig in two longitudinal rows when they are said to be *2-ranked*, as in the mulberry (fig. 9), or in several rows when they are *more than 2-ranked* as in the Poplars (fig. 6).

The size and shape of leaf-scars are important factors in identification. They may be very narrow as in the Pear and their upper margins may be flat or convex as in the Black Ash or deeply notched as in the White Ash or form a band nearly surrounding the bud as in the Sycamore.

At the bases of the leaves of some species a pair of small leaflets called stipules are regularly formed and leave, at the fall of the leaf, more or less definite *stipule-scars* at either side of the leaf-scar as shown in the Carolina Poplar (fig. 6).

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The number, the size, the relation to the surface of the leaf-scar, whether sunken or projecting, and the distribution of the bundle-scars form important points of distinction. When they are indistinct, as is frequently the case, they may be revealed if a thin slice is taken off the surface of the leaf-scar.

Buds—Buds produced at or near the nodes but not in the axil of a leaf-scar are called *accessory buds*. Of these there are two kinds: *Superposed buds* located above the axillary buds and *collateral buds* located at either side of the axillary buds. The former are shown in the Butternut (fig. 7) and the latter in the Red Maple (fig. 8).

Most species by the end of the growing season have formed terminal buds which remain through the winter and are destined to continue the growth the following spring. In some species, however, such as the Mulberry (fig. 9) the terminal bud together with the tip of the twig dies away and drops off before the beginning of winter leaving a small scar at the end of the twig. The presence or absence of the terminal bud is a very valuable point of distinction and is used throughout in the keys. Unfortunately it is not always possible at a cursory glance to say whether the terminal bud is present or absent and a hand-lens must generally be used for an accurate determination of this point. In the Mulberry figured, the self-pruning scar formed by the dropping off of the terminal bud is perched on the tip of the twig with the topmost lateral bud obviously in the axil of the last leaf-scar. Frequently, however, the self-pruning scar may be nearer the lateral bud which bends in and gives the appearance of being terminal. The presence of a leaf-scar below it shows that it is in fact axillary, but since leaf-scars are sometimes present toward the end of twigs without buds in their axils the presence of the self-pruning scar at the twig end must be used as the decisive sign that the terminal bud is really absent.

Aside from the color, the presence or absence of hairs, stickiness, fragrance and other such surface characters, the position of the buds in relation to the twig may be of importance. Buds that lie close up against the twig as those of the Small-toothed Aspen are called *appressed*, while those that project more or less away from the twig as those of the Carolina Poplar (fig. 6) are called *divergent*. In the Common Locust and a few other forms the buds are sunken below the surface of the twig, and can be found only by cutting the twig lengthwise through the leaf-scar.

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Common Rocks and Their Determination

By W. A. Tarr,

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SECOND PAPER.

A working knowledge of the more common minerals would naturally lead us to study their associates, the rocks, which are composed of minerals. Some are composed of a single mineral and some of several. The opportunities for studying rocks are even greater than for studying minerals, as the former are present in every locality in abundance, although the actual number of varieties may not be many. The hills and the valleys, the mountains and canyons are features on the earth's surface which are formed by the two agents, wind and water, which cut away parts of the rock.

A stroll through the fields or a walk along a nearby creek will usually reveal several kinds of rocks. They will be found outcropping along the banks and small gullies and in the creek beds. Sometimes a very hard layer will cause a small fall in the brook. Along railroads there are usually good exposures of rocks. In some flat regions where the soil is thick there may not be very good exposures, but wells in the neighborhood or a large river may supply material for the students to work upon. Exchanging specimens with the children of another region will give a greater variety and number of rocks to work with and study, though in this case they will not have the benefit of seeing the rocks in place.

But suppose we do see the rocks and minerals in the fields what do they mean to us unless we know something about them? Nothing at all. But if we know that one, for example, is an igneous rock, and that it probably came from many miles below the earth's surface, we may infer something about the rocks on the interior of the earth. Or limestone with its many fossil shells tells us of a time, possibly millions of years ago, when animals lived in those same shells which now go to make up the limestone. And we find fossils of animals and plants in other rocks, in shales and sandstones and in coal, and these all tell of times long since past, when these forms of life flourished on the earth. And these sedimentary rocks tell us also that the sea or some large lake has been over the very place where we are stand-

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ing. This is a wide view into the past to be gained from an uninteresting looking piece of rock, is it not? Suppose we find a metamorphic rock, say a schist, in which there are beautiful crystals of garnet. What does it suggest? It tells us that the rock was buried miles below the surface of the earth where the pressure was so great that the original rock from which the schist was formed was crushed and broken and new minerals formed. And then the earth's crust was folded and broken and mountains were formed and after a long period of erosion the rocks were exposed as we find them today.

The rocks as we find them exposed at the surface are full of joints and cracks. Water gets into these openings and dissolves out some of the material and carries it away. In winter the water freezes and this helps to widen the joints and cracks and causes the rock to crumble and break up. The summer heat expands the rocks then they contract and break and split up. The roots of plants and trees also get into these openings and aid in prying the rocks apart. Through the mechanical action of the freezing, thawing, etc., and the chemical action of the water and the acids it contains the rock is decomposed. Much material goes in to solution and is carried away by the streams to the ocean. Many minerals are changed, but some, such as quartz, are not attacked by the solutions very much. These various products of decay form the rock debris of which the upper portion is called soil. In some areas that are nearly flat the soil is thick, in other areas that are rough much of it is carried away by the streams. Evidence of this is shown by the muddy streams after every rain. The forests and grasses aid in keeping the soil on the slopes by holding the particles together with their roots. As soon as the forests are removed the streams begin to remove the soil. In some areas, the Southern Appalachians, for example, thousands of acres are worthless now for this reason. Many places can be found where the gradation of the unaltered rock into the soil may be seen. The study of this change is very interesting.

There is a constant but usually very slow movement of this decayed material to the sea. In the sea it supplies the material for the future beds of limestone, shale and sandstone. There are various estimates of the rate at which the surface of the United States is being lowered. A recent estimate by the United States Geological Survey is that one foot is being removed in 9,120 years. 270,000,000 tons of dissolved matter and 513,000,-

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000 tons of suspended matter are carried to the sea every year. Another estimate, but only for the Mississippi valley, is one foot in 3,500 years. Whatever the rate may be, the constant wearing away of the land supplies material for beds of sediments now being deposited in the sea.

As a definition for a rock we may use the following: a rock is a mineral or a mass of minerals that forms an *essential* part of the earth's crust. By this definition many things that are not commonly regarded as rocks, become rocks, such as the soil, sand hills, and clay deposits. The important feature is that the rock shall be an essential part of the crust. (By crust we mean merely the outer part of the earth and do not in any way refer to its origin.) The size of a rock cannot be arbitrarily fixed. Gypsum, salt, and limestone (which consists almost entirely of calcite) are examples of rocks that are composed of one mineral. The greater part of the rocks of the earth's crust is composed of more than one mineral. All the common minerals that are found in rocks are included in the table of common minerals in the previous paper on this subject, hence any one should be able to determine the minerals in the more common rocks, and knowing these, the rock name can be easily found. Familiarity with the common rock-forming minerals should be acquired by all before beginning to work with the rocks.

There are three principal classes of rocks. They are as follows: igneous, sedimentary and metamorphic. Ninety-five per cent of the outer ten miles of the earth is estimated to be igneous rock and five per cent is sedimentary. The metamorphic rocks are also included in this estimate. Of the sediments four per cent is shale, three-fourths of a per cent sandstone and one-fourth limestone.[1] The igneous rocks are those that have been formed by the solidification of molten masses from within the earth. They are the primary rocks from which all others have been derived, in fact they were once called "primary rocks." When the igneous mass solidifies below the surface it is called an intrusive rock. Since the process of cooling under these conditions would be slow, the minerals that compose it would have an opportunity to grow large, hence intrusive rocks are generally coarse grained. The intrusive rocks have various modes of occurrence. When they fill long narrow fissures or joints cutting across the other rocks they are called dikes. When they are in thin layers between beds of other rocks they are known as sills. Large irregular

[1]Clarke, Bulletin 491, p. 32, U. S. Geol. Survey.

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FIGURE 1.—Massive Granite Stone Mountain, De Kalb County, Ga. (Watson, U. S. Geol. Sur.)

forms are known as batholiths. When the molten mass flows out upon the surface of the earth it is called an eruptive or volcanic rock. Such rocks are also known as lavas. They may occur either as great flows covering many thousands of square miles or the molten material may pile up forming mountains which are commonly known as volcanoes when lava is still erupted. Since the molten mass which flows out on the surface cools quickly, the various minerals that would have formed had the mass been an intrusive one, do not have time to grow so such rocks are generally glassy or the crystals are so very fine that they cannot be seen with the naked eye or even with a good lenses.

Igneous rocks are distinguished from other rocks by their massive and usually grained character. (See figures 1 and 4.) There are no bedding planes such as are found in sedimentary rocks and they are not banded like the metamorphic rocks. Since each rock is composed of varying proportions of the rock-forming minerals and since the rate of cooling is not the same for all rocks it is to be expected that the sizes of the minerals and their relation to each other will vary widely. This feature is known as the *texture* of rocks. Thus, we have coarse-grained textures, fine-grained textures, glassy textures, porphyritic textures, etc. We have a porphyritic texture when some of the crystals of the rock are larger than the remainder. (See figure 5). Such a

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FIGURE 3.—Gneiss from Leete Island Quarry. Showing gneissoid texture due to squeezing and stretching of granite.

rock is sometimes called a porphyry. It is better though to use the term in connection with the proper rock name, thus, granite-porphyry, syenite-porphyry, etc., or basalt-porphyry. A rock is said to be coarse-grained when the crystals are larger than peas and fine-grained when they are smaller than fine shot. It should be noticed that the crystal grains that go to make up the rock are rarely ever perfect in shape. As they grew they crowded against each other and were thus prevented from assuming their true form, so that they appear in the rock as more or less irregular grains. Joints are very common in the massive igneous rocks. They may be at all angles, from vertical to horizontal. These joints are often of great assistance in quarrying the rocks.

There are a great many varieties of igneous rocks because there is a wide variation in the mineral composition, but for general use and in the field a series of names have come into use that make it possible to bring similar rocks together into groups under a few simple names, as the following table shows.

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CLASSIFICATION OF IGNEOUS ROCKS. (after Pirrson)

I Grained, constituent grains recognizable. Mostly intrusive.				
	Feldspathic rocks, usually *light* in color		Ferromagnesian rocks, generally dark to black	
	With quartz	With little or no quartz	With subordinate feldspar	Without feldspar
Non-porphyritic	Granite	Syenite	Dolerite	Peridotite (rare)
Porphyritic	Granite-porphyry	Syenite-porphyry	Dolerite-porphyry	
II Dense, constituents wholly or partly unrecognizable. Mostly extrusive rocks.				
	Light-colored, white, light gray, red, yellow, brown, light and medium green. Usually feldspathic		Dark-colored to black, very dark green or very dark gray. Usually ferromagnesian	
Non-porphytitic	Felsite		Basalt	
Porphyritic	Felsite-porphyry		Basalt-porphyry	
III Rocks composed wholly or partly of glass. Extrusive.				
Obsidian, pitchstone, pumice, rarely porphyries of these.				
IV Fragmental volcanic material, tuff, volcanic ash.				

FIGURE 4.—Granite from the Booth Quarry, Waterford. Showing granitic texture.

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The feldspathic rocks are those that contain feldspar. The ferro-magnesian rocks are those that contain a considerable amount of the minerals that contain iron and magnesium. They are as follows: hornblende, pyroxene, biotite, and olivine. One or more of these minerals is nearly always found in the feldspathic rocks but in small amounts, less than one-fourth of the rock usually. Since the color of a rock is the color of the mixtures of the various minerals it contains, it is readily seen that the rocks that contain very much of these minerals would be dark. The same reasoning applies to the feldspathic rocks.

The above table is not only a general classification of igneous rocks but is also a determinative table. Thus a light colored rock which has grains that can be distinctly seen and which contains feldspar and quartz, all the grains being about the same size, or non-porphyritic, is a granite. It is a very good plan to memorize this table then it is always ready for use.

Hygiene as Nature-Study

F. M. GREGG.
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IV. A STUDY OF THE MOUTH AND ITS USES.

Next in magnitude to the proportion of people affected by germ diseases comes the proportion of people who are affected by the ills to which flesh is heir in consequence of bad feeding. In more exact diction, flesh is not "heir" to either of these causes of human illness, except in so far as there is a figurative heritage of customs and environment, for diseases due to the two general causes named are in large degree, if not wholly, within the control of the individual. The matter of feeding is so largely subject to modification through habit that it is manifestly a part of the school's duty to supplement the efforts of the home in securing right habits early in the life of the pupil, with respect to eating. Fourth and fifth grade pupils are none too young upon whom to operate for the end desired in feeding practices. Malnutrition, alleged to characterize one pupil in four in America, is in part, at least, traceable to undesirable habits of eating. This may in turn be traced to various causes, among them to decayed teeth and rapid eating.

(*a*) THE NATURE-STUDY APPROACH.

1. *A study of the mouth cavity.*—(a) As an important pre-

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liminary study pupils may be directed to take a hand mirror and examine the mouth cavity. The effort here should be to have the pupils discover and describe the different structures found in the mouth. It will help to motivate this study if it be turned into a kind of contest to see who can make the greatest number of such discoveries. The pupils should be particularly directed to discover the places in the mouth at which saliva is seen to empty into it. To this end he should be directed to take a small bite of cracker, in order to start the flow of saliva, and then to note the points of salivary inflow.

(b) After the teacher has gotten from the pupils the reports of the results of their studies, she may summarize by placing on the blackboard a sketch of the figure given below (a diagrammatic representation of the mouth opened so wide as to show its upper and lower parts as if they were hinged back into one plane). Indeed, the sketch may well be on the board when the pupils' reports are called for, the final summarizing consisting of a tabulation of the structures that may be seen.

2. *Uses of the mouth.*—(a) Pinch the nose shut for a minute or two. What use is the mouth now serving? After one has been running hard for some time is it possible to get sufficient breath merely through one's nose? Summarize in one statement one of the uses of the mouth.

(b) Give all the elementary sounds you can of each of the letters of the alphabet. What difference do you observe in the use of the mouth in the making of the sounds of the consonants and of the vowels?

(c) Have you noticed how chickens and birds drink water? Why do not people also have to throw back their heads as much as birds when they drink? What use does this suggest for the human mouth?

(d) After having taken a good big bite of cracker can you swallow it at once even if it is well crushed? What use have we here for the mouth?

(e) What uses does the mouth serve in connection with the eating of apples and such things?

(f) Put some raw corn starch and some cooked corn starch (starch paste) in water and see if it dissolves. Could food of exactly this sort be easily gotten into and carried along by the blood? Put some cane or grape sugar in water and note whether it dissolves or not. Now give each pupil a "bite" of raw corn starch, and let him chew it but not swallow it for a minute or

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two. How does it now taste? What does the saliva seem to be doing for the starch? Why? Now try some of the cooked starch and see if there is any difference in the time it takes till the sweetish taste begins to appear. What do you learn from this?

3. *The mouth in relation to foods other than starch.*—(a) Provide each pupil with a small mouthful of clean wheat grains and let him chew until a small mass of "wheat gum" remains that will not dissolve in the saliva. Explain that this is a kind of food that the mouth will not digest. It is called gluten and belongs to a group of foods called proteids (be sure to pronounce the word in three syllables if you use it at all) such as are digested in the stomach and small intestine. Similarly try a bit of the white of a hard boiled egg and see if it dissolves in the mouth. Is the white of egg a starchy food? Try dried beef also.

(b) Direct each pupil while at home to put a bit of butter alone in the mouth. Did it dissolve, or did it just melt? Butter belongs to a group of foods known as fats, and these are not digested until they reach the small intestine.

4. *Simple studies of starch.*—(a) Does one find much starch in foods and is it present in many foods? There is a liquid we can get at the drugstore called iodine solution that we can easily use to find out whether the various foods we eat contain much or little or no starch. Putting a few drops of iodine on bread or potatoes we notice that it turns dark blue, which is a sign of much starch. Thoroughly cooked beans or peas will turn but slightly blue with iodine showing little starch. Raw apple will not turn at all, showing that it has no starch. Try a number of common foods and make a list of those containing much, little and no starch. Is starch present in any great degree in what we eat?

(b) Try starch in some form to see if it can be burned.

(b) HYGIENIC CONCLUSIONS.

Men who have studied the question of foods very carefully tell us that for adults to live healthily they need to eat six times as much of starchy foods as they do of proteids and of fats. They say that for a day's feed one needs fifteen ounces of starchy food (carbohydrate) to two and a half of proteid and two and a half of fat. That is, for an average meal, one needs a little less than an ounce of proteid and of fat and five ounces of starchy food. Since starch is present in so many foods, do you see any reason why food generally should be thoroughly chewed

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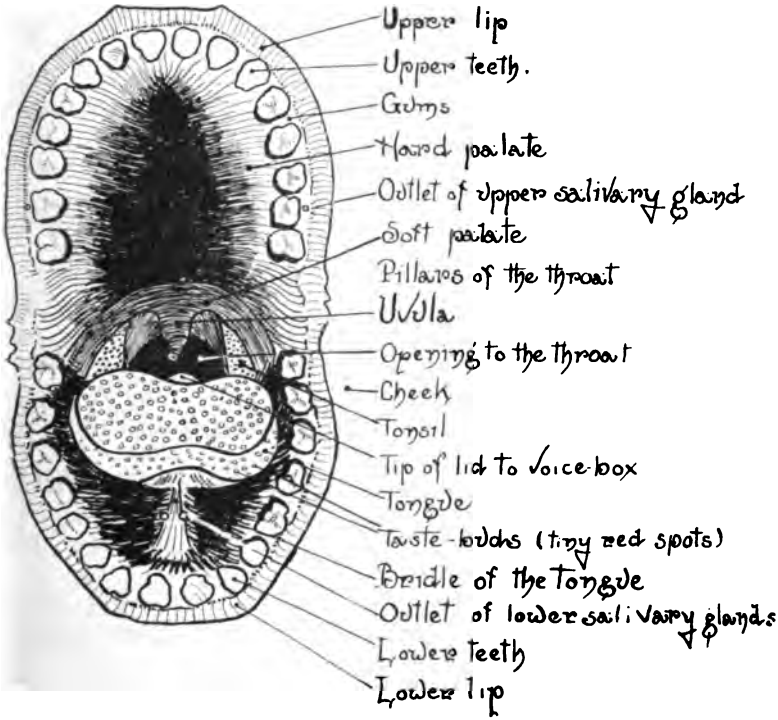
before it is swallowed? It is true that starch is also digested in the small intestine, but then it is in the road in the stomach and interferes with the chief work of the stomach—the digestion of meats. Besides, if one does not take time to chew food well what else does he lose by it, judging from your experience with 2(f)?

They also say that if one has but little to eat he can get much more good out of it if he chews it thoroughly. You can prove this for yourself by eating, say, a single sandwich for



luncheon quickly one day and very slowly another day and comparing your states of hunger by supper time for the two days. They also say that one is not nearly so apt to overeat and thus bring on dyspepsia if one eats slowly. You can easily try this out also. Eat all you want, say at noon of two successive days, one day slowly and with much chewing, and the other day rapidly and with little chewing. Compare the quantities eaten at the

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two meals. After all this study, what do you think is the wisest way to eat? What will you do about it?

(c) SOME FOLLOW-UP STUDIES.

1. The pupils will be further motivated into habits of thorough mastication by a study of the story of Gladstone and his chewing each bite thirty-two times—one chew for each tooth, combined with the fact that he lived to a vigorous old age. The story of Horace Fletcher should come in here. The best accounts are found in the magazines of a few years ago. Fletcher's wonderful endurance as related in the Popular Science Monthly for December, 1907, page 537, is sure to interest boys.

2. These studies may be advantageously followed by other food studies, with simple experiment, as given in the physiologies generally. After the nature-study introduction the pupils may be sent to the books for additional information. They can then be trusted to read rapidly and understandingly.

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The Nature Study Society is justly proud of the several thriving local sections that are coöperating to increase the interests in nature and nature study. The following are the efficient officers:

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RED-SHOULDERED HAWK.
½ Life-size.

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Common Rocks and Their Determination

BY W. A. TARR,
University of Missouri.

THIRD PAPER.

The sedimentary rocks constitute the second class. The word sedimentary is applied to these rocks because they are lain down or deposited in water. This entire class of rocks is derived from other pre-existing rocks. All rocks when exposed to the various agents of weathering, such as the air, water, changes of temperature, acids, etc., at the surface, alter to simpler minerals that do not decompose under the conditions that exist there. The most of the minerals so formed are kaolin (the mineral which clay is very largely composed of), calcite, limonite, salt (which goes into solution and is carried down to the sea or to lakes) and some other less important minerals. Quartz, as mentioned above, does not alter except very slowly. We can only trace briefly, in this short paper, the history of these various products before their deposition, however interesting it may be. The wind and the water work upon the rock debris and the various particles are separated, usually according to size. The particles that are small enough are carried away by the streams to the sea, along with the material that was taken into solution. This material carried by the streams is commonly called sediment and on reaching the quiet waters of the sea or lake it settles down to the bottom. The first material dropped is the sand, which will become standstone later on; the fine material will form the mud, which will become shale; while the

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calcium carbonate in solution becomes limestone. When the sea water is evaporated in a basin the salt and gypsum which it contains are precipitated and form beds of these rocks.

The loose plastic materials become hard and firm by being cemented by various materials and squeezed together by pressure. The coarse material such as the pebbles of a conglomerate and the coarse sandstones must be cemented to become hardened, while pressure will compress the soft muds and calcareous material into firm rocks. Some of the more common cements are calcium carbonate, iron oxide, silica, and sometimes mud. These cements may be introduced into the rock while it is yet in the sea or they may be buried and consolidated while under the water and after they are raised above the sea bottom to form land the water may deposit the cement in the openings between the particles. As more material is brought into the sea and deposited, it buries that below, and the weight of the overlying beds is in most instances sufficient to consolidate the beds of soft material into firm rocks. The enormous pressures that the rocks are subjected to when they are folded into mountains also aids in consolidating the rocks, in fact, the pressures and heat developed during the formation of mountains are sufficient to change the rocks so much that they become metamorphosed into very different rocks which will be described later. It is thus that the soft sands and muds become the usually firm hard rocks that we know.

The sediments are always in beds or layers and are commonly spoken of as being stratified. (See figure 2.) It is in this feature that they differ from the igneous rocks. Their composition is also very different from that of the igneous rocks. The limestones and dolomites are carbonate rocks which are easily dissolved in acids and are also usually soft, about three or four in the scale of hardness. The shales and sandstones also differ in composition from the igneous rocks and can also be readily distinguished from the igneous rocks and each other, the former by its well marked bedding planes, its softness and clayey odor, and the latter by its being composed of rounded grains (these may be of quartz, feldspar and various other minerals), its friableness and its bedded character.

There are all gradations between the various sediments so that one could get a complete series between any two sediments. The shales may be calcareous and with an increasing amount of calcium carbonate and a decreasing amount of clay they would pass into a limestone, or if sand became abundant it would be

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FIGURE 2.—Sedimentary Rocks Showing Horizontal Stratification, Penn. (Campbell and Battis, U. S. Geol. Sur.)

called a sandy shale and might even pass into a sandstone, and this might in turn, by an increase in the size of the particles composing it, grade into a conglomerate. Likewise, we have sandy limestones and calcareous sandstones. A very fair estimate of the amount of the various materials in the rock may be obtained by carefully noting the hardness, for the presence of the sand grains would increase the hardness of a shale or limestone, or the calcareous cement in a shale would make it harder. Treatment with acid also suggests the amount of the impurity. But taken as a whole, the majority of the sediments are nearly pure so that not a great deal of difficulty will be experienced in determining them.

The sediments are of a great many colors, white, gray, red, yellow, brown, green, black, and many others are very common. The red, yellow, green, and brown are due to iron oxides. The red is due to hematite and the yellow to limonite (iron rust).

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The various shades of these are due to mixtures of the oxides. The gray and black colors are due to carbonaceous matter in the rock. The color of the fresh rock is usually different from that of the altered part at the surface. This change in the color is very noticeable in the quarries where the fresh and altered rocks are exposed. Various minerals are occasionally found in the sediments. Some of the most common are the chert and flint in limestone, pyrite in shales, limestones and coal, quartz crystals in cavities in the limestones, shales and sandstones. gypsum crystals in shales and coal, and limonite and hematite in shales, sandstones and limestones.

The character of the underlying rock determines the kind of soil above it. The shales give rise to a clayey soil as would naturally be expected, while the sandstones make sandy soils. Limestone generally decomposes by the calcium carbonate going into solution and any insoluble impurities in it remaining behind as a residual soil.

Limestones and dolomites are calcium carbonates, and calcium-magnesium carbonates respectively. They are usually dense fine-grained rocks (see Fig. 9) although dolomites are often porous and limestones, rarely. They break with a sub-conchoidal fracture (see Fig. 9). Both rocks may contain a great many fossils, and when they do they are often called fossiliferous limestone or dolomite. Sometimes the amount of organic matter in the limestone is high and then it is called carbonaceous limestone. Lithographic limestone is a very dense, fine-grained limestone used in lithographing. There are numerous other varieties. Limestones and dolomites occur in layers or beds often hundreds of feet thick. There is a series of limestone beds over a mile thick in the western part of the United States. Shales, sandstones and sometimes conglomerates are found with limestones. Occasionally valuable ores are found in them, but they came from associated igneous rocks. In the following arrangement of the sediments it is seen that the carbonate rocks originated through organic processes. This is probably true in many instances but not always as some limestones and dolomites are probably of chemical origin. The uses are the same as those given for calcite in the paper on minerals.

The shales and clays consist of various minerals but the chief ones are kaolin and quartz. The particles are very fine and are deposited in quiet waters, hence shales are dense fine-grained rocks. Shales occur in beds, the layers of which vary in thickness from a sheet of paper to many feet. Some shale forma-

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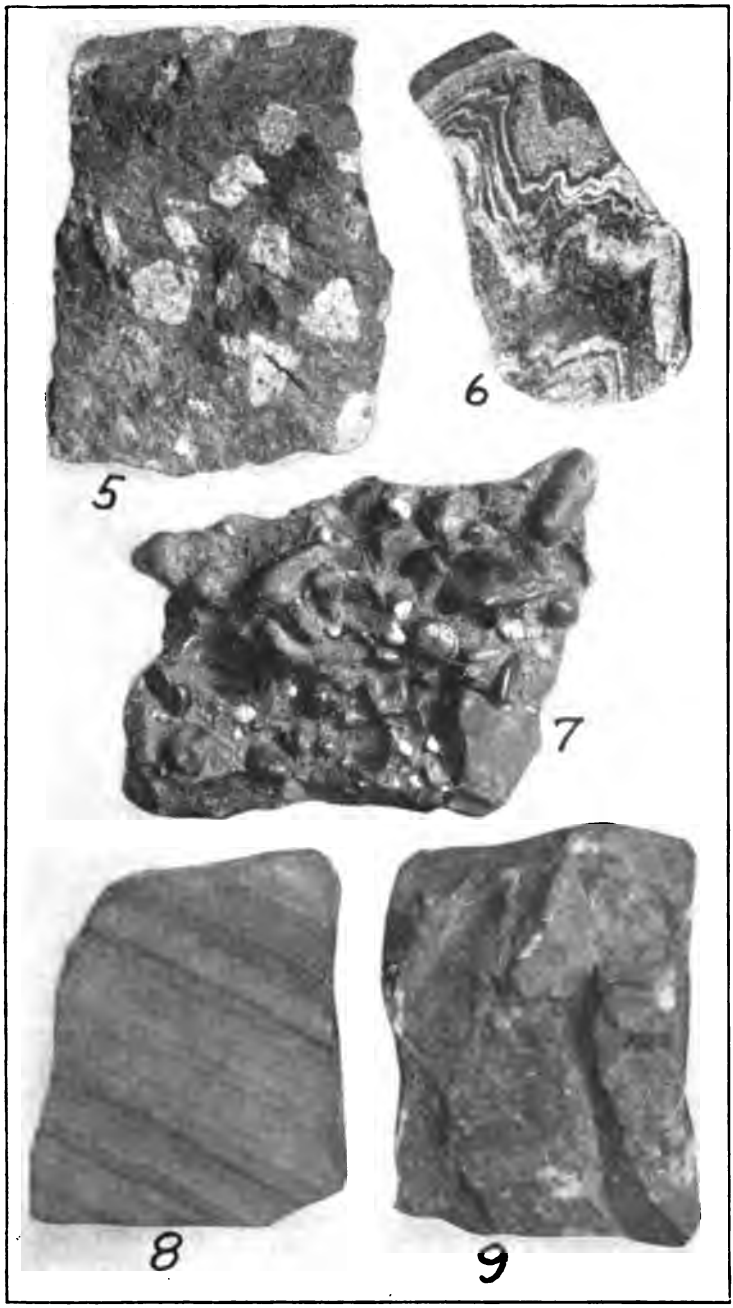

FIGURE 5.—Porphyry Showing Large Crystals of Feldspar.
FIGURE 6.—Closely Folded Schist.
FIGURE 7.—Conglomerate.
FIGURE 8.—Sandstone Showing Thin Layers and Small Fault on the Left Side.
FIGURE 9.—Limestone.
(All figures are reduced to about one-fourth natural size.)

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tions are hundreds, even thousands of feet thick. The clays are about the same as the shales in structure. Fossils are very common in shales and are usually well preserved. The grading of shales into other rocks was mentioned above. There are various kinds of shales, some of the more common being calcareous, carbonaceous, ferruginous, arenaceous (sandy) and fossiliferous. Shales are used for making brick and pottery and are mixed with limestone for Portland cement, etc. They are frequently called by the name of the product they are used to produce, as brick clay or shale, pottery clay, etc.

Sandstones and conglomerates differ from each other in the relative size of the materials composing them. When the particles are larger than a pea (they may be twenty feet or more in diameter) the rock is called a conglomerate (see Fig. 7), when the particles are smaller than a pea it is called a sandstone (see Fig. 8). It can be designated as a coarse, medium or fine-grained sandstone. The sandstone may be in very thin or in very thick beds, but the conglomerates form a single bed which may be hundreds of feet thick. Cross-bedding, where there are diagonal bedding planes crossing from one horizontal bedding plane to another, is a common feature of sandstones. Sandstones are deposited near the shore where changes in the direction of the currents are frequent and the cross-bedding is due to these changes. Sandstones are often named from their cement as, calcareous, ferruginous, and argillaceous (clayey) sandstones. They are commonly used for building purposes, more rarely for grindstones and in the manufacture of glass, etc.

Salt beds are rarely exposed at the surface but their presence is often indicated by salt springs. Salt in beds occurs in New York, Michigan, Louisiana, Ohio, Kansas, Utah and Texas. In some of the states it is more than one hundred feet thick. Gypsum is very often found associated with salt. It is known to occur in beds one hundred or more feet thick and is found in New York, Michigan, Virginia, Iowa, Kansas, California, Texas and many other states. Both these rocks occur interbedded with shales and sandstones and sometimes with limestones. The limestone is generally found with the gypsum. When gypsum is found in sufficiently large amounts and pure enough it is used in the manufacture of cements and plaster of Paris.

Coal is formed by the accumulation of vegetable matter in swamps such as the Dismal Swamp. The water prevents the material from decaying as it would if it were exposed to the air. Evidence of this rapid decay is seen in every forest. It is esti-

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mated that it requires fifteen to thirty feet of peat to produce one foot of coal and that the process takes three hundred years. Another estimate, probably nearer correct, is that it requires eight or nine thousand years for the formation of one foot of coal. About three hundred feet of coal (the total thickness of all the beds) is known in the Appalachian region, hence the time required to deposit it varies from 90,000 to 2,700,000 years, if we base our estimate on the above rates of accumulation. Some single anthracite coal seams are sixty feet thick, so we can get some idea as to the great length of time it required to make this one seam. After accumulation has gone on for a long time sands and muds may be washed into the swamp and the accumulated material buried. Various gases are driven off and the carbon of the original wood with some of the hydrocarbons and the ash are left behind to form the coal as we find it today.

The two common kinds of coal are soft or bituminous coal and hard or anthracite coal. The bituminous coal fields are found rather widely distributed in the United States, but the productive area of the anthracite is confined to 480 square miles in eastern Pennsylvania. The United States produces more coal than any other country in the world. Bituminous coal breaks into cubical blocks, is soft, brittle, appears banded and burns with a long smoky flame. Anthracite has a shell-like fracture or break, is hard and shiny, very brittle, does not ignite easily and burns with a short flame.

Summarizing then, the sediments can be arranged according to origin as follows:

Mechanical deposits of residual material.
- Conglomerate.
- Sandstone.
- Shale.

Chemical deposits of dissolved material.
- Salt.
- Gypsum.
- Some limestone and dolomite.

Deposits made through the agency of life.
- Coal.
- Limestone and dolomite.
- Siliceous rocks, as diatomaceous earth.

The last division of rocks is the metamorphic class. This group includes rocks which have originated by the changing of the other two classes, hence the name metamorphic which means "change of form." By means of great heat and pressure and

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the presence of water the granites and other igneous rocks may be made to change into gneisses and schists, while the sediments become slates, marbles and schists. The original rock and its metamorphic equivalent are given in the table below:

Original state.	Intermediate form.	Metemorphic rock.
Clay	Shale	Slate
Sand	Sandstone	Quartzite
Gravel	Conglomerate	Conglomerate schists
Calcareous material, shells, etc.	Limestone	Marble
All feldspathic rocks		Gneiss
Ferromagnesian rocks and other igneous rocks.		Schists of various kinds

This outline shows at a glance the relation of the metamorphic rock to the original rock. It must not be thought that there is a distinct dividing line between the original and the metamorphic rock, for there is not. The one grades insensibly into the other so that all gradations are found. This need not present any difficulty for our purpose. If the features commonly seen in a gneiss can be determined in the specimen in hand, even though faintly, call it a gneiss. This is satisfactory for a field classification such as the one given here. If the gneissic features are developed, as noted above, and the minerals are those of a granite, the rock may be called a gneissic granite.

The distinctive features of gneisses and schists are the arrangement of the minerals into more or less parallel bands and the development of a fairly good cleavage in the rock. (See figures 3 and 6.) This cleavage is due to the fact that minerals with good cleavage are developed during the process of metamorphism. The micas with their perfect basal cleavage and the long slender hornblende crystals with their good cleavage are the most common of these minerals. Gneisses always contain feldspar and are nearly always more coarsely blended than the schists. This fact should be noted in determining a gneiss. The schists very commonly show a great deal of mica on the cleavage plane and are often very thinly banded, as thin as a sheet of paper or thinner. (See figure 6.) The bands in both rocks are often bent and folded. (Figure 6.) Garnets and crystals of magnetite very often occur in gneisses and schists. These rocks are very commonly found in regions where mountains have been formed, hence we find them from Maine to Georgia and Alabama, and in a great many localities in the western part of the United States. In areas where the very oldest rocks we know are found there are always a great many metamorphic rocks as in Wisconsin, Michigan, Minnesota and many other states.

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The color of the metamorphic rocks vary as widely as the igneous rocks. The gneisses usually have colors similar to the granites, etc., from which they have been derived. If there is an abundance of the dark minerals the rock is dark gray, or sometimes it is greenish, or nearly black if the dark mineral is biotite. The schists are light-colored also, if the predominating mineral is light colored. This is especially true of those schists which contain a large amount of white mica. Many schists are greenish in color and still others are almost black.

Schists and gneisses may be given a more specific name if it is so desired. If some mineral is very abundant in the rock the name of this mineral may be prefixed to that of the rock, thus: garnet-gneiss, or hornblende-gneiss, or biotite-gneiss, etc. Similar names are applied to the schists. If two minerals are abundant then both names are used, as, biotite-muscovite-gneiss.

The soils that are derived from the metamorphic rocks vary as widely as the nature of the rocks from which they themselves have been derived. Very frequently the gravel in the streams which flow from gneisses and schists contain many of the harder minerals that were in them, such as garnets, magnetite, etc.

When limestone is metamorphosed it becomes marble. The change that takes place is not a change of material, but is a rearrangement of the material already there; thus larger crystals of calcite (for limestone is composed of calcite) are formed. This is what gives the coarse texture to many marbles, although the texture of marbles varies from very fine to very coarse. When the original limestone is very impure then the resulting marble will contain many minerals as impurities. These usually make the stone unfit for use. A great deal of the marble produced in the United States is quarried in Vermont, but it is also found in Massachusetts, Maryland, New York, Georgia, California, Colorado, and many other states. Marbles are easy to distinguish because they are crystalline, easily scratched with a knife and effervesce with acids.

Quartzite is formed by a sandstone being cemented with silica. It is a very hard, dense rock, having various colors. It can be distinguished from a sandstone by the fact that it breaks through the grains of which it is composed while in a sandstone the break is around the grains. Quartzites are very common and are found in nearly all the states. The Indians used quartzite sometimes to make their arrow heads.

Slate is a rock that has a very remarkable cleavage so that it splits easily into very thin, large sheets. It is a dense, fine-

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grained rock and is usually gray, black, green or red in color. Slates are formed from fine-grained rocks, chiefly shales and clays. They may be told from shales by their more perfect cleavage, shiny surface on the cleavage face and their superior hardness. Slate is used for roofing, for school slates, slate pencils, blackboards, wash-tubs, for lining refrigerators, and has a great many other uses. It is found especially in Pennsylvania, Vermont, New York and Maine.

The first thing to do on finding a rock is to decide into which of the three groups it belongs. Not only should the texture and the minerals of the rock be observed, but the structure of the rock in the field should be observed, if possible, as it will be a great aid in determining the rock. As soon as it is known into which group the specimen belongs, the descriptions of the members of the group should be applied to it. If it is an igneous rock it will be found to fit into the table given above. If it is a sediment, there will be no difficulty in telling the conglomerates and the sandstones, but it is harder to distinguish the limestones and the shales, especially to tell them from one another. Since the limestone is easily soluble in acids this test can be used to distinguish them, if there is some acid at hand. A few cents' worth of dilute hydrochloric acid purchased at a drug store will be found to be a great aid in working with the sediments. But sometimes shales are very calcareous and under such circumstances the *ease* with which they effervesce will aid in separating them. There will also be considerable insoluble matter left if it is a calcareous shale. Another feature of shales is their clayey odor when moistened either by breathing upon them or by wetting them. Shales are usually more finely laminated than limestones. Only the more common kinds of the metamorphic rocks have been mentioned because in a short time the list would have become entirely too long for this short paper.

The knowledge of a few of the common rocks is very useful and important. Familiarity with a few will lead to the acquaintance with more and will give the student a better understanding of the composition of the earth around him. The real student does not stop with learning the few. They are merely the stimulus to search for more information, for a wider working acquaintance. It is sincerely hoped by the writer that all who read this paper will be helped, and that all will unite in bringing the children into a closer working relationship with the rocks and minerals that are around them.

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A Study of Wind-Blown Sand

GEO. J. MILLER

[Editor's note.—The following article outlines some work in geography by the "nature study method." The second article is the work of a student, showing the reaction to such instruction.]

OBJECT AND METHOD OF FIELD WORK.

The primary things to be gained by a field trip in geography is ability to interpret correctly a geographic feature in all its relationships and to learn geographic facts first hand. It is obvious that the training involved in field work is far more important than the learning of facts. The student, therefore, should be led to discover and interpret the field matter. The teacher should be the leader, but should give information only when it cannot be gotten from the students themselves. If necessary let them work on a problem during the entire trip or for several days thereafter. If field work is done before the subject has been studied in the class room more information will have to be supplied by the teacher, but, even then a surprisingly large amount can be supplied by the students. So far as possible it is best to study the subject in the field first.

WIND-BLOWN SAND.

What subjects are to be investigated in a study of wind-blown sand? The subjects do not change materially whatever the age of the student, but the variables are the amount that can be accomplished and the quality of the work done. In general the following topics or problems are considered:

1. Sources of the sand. 2. Movement of the sand.
3. Work done by wind-blown sand. 4. Life of a dune area.
5. Human relations.

SOURCES OF THE SAND.

The immediate source of the sand may be sandstone rock, lake or ocean shores, or rivers. If from sandstone, exposures of the rock probably will be found within the dune area or to the windward of it. If from lake or ocean shores, or from rivers, the sand may have been derived from distant or local sandstone or sorted from soil by wave or stream action. If Lake Michigan be taken as an example the immediate source is the soil along its shores. The soil in this case is almost entirely glacial drift and the sand is sorted from the drift and carried along the shore by shore currents. When washed upon the beach it soon dries

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FIGURE 1.—Dune advancing over the Calumet River. Partially buried cottonwoods are shown on the active dunes and an oak forest on the stable dunes.

and is then blown about by the wind. Since the wind prevails from the west in this latitude few dunes are found along the west shore of the lake.

MOVEMENT OF THE SAND.

The great motive power in moving sand on the land is the wind. Any small obstacle will cause upward currents in the wind and it is these currents that enable the wind to *pick up and keep up* the sand grains. But since each grain has a very small surface in proportion to its weight it is not caried very high, hence the movement consists primarily in rolling the grains along the surface or, at best, in carrying them only a short distance and then repeating the operation. The movement of sand, therefore, takes place only in the lower air. If, for any reason, the wind is checked the grains will fall and a pile of sand may accumulate.

WORK DONE BY WIND-BLOWN SAND.

It is obvious, therefore, that a permanent or semi-permanent checking of the wind will result in building a *sand dune*. Among the most common obstacles that start a dune are young shoots of trees, shrubs, and grasses. Some, as the cottonwood and dogwood, have the ability to send out roots from their trunks and keep above the accumulating sand, thus forming a constant obstruction to the wind and aiding rapid dune building. However,

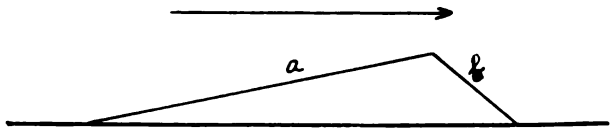

FIGURE 2.—Diagram illustrating the gentle windward (*a*) and steep leeward (*b*) slopes of a dune.

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such growth cannot go on indefinitely (1) as there is a limit beyond which plant life cannot sustain itself under such conditions, and (2) if a dune grows beyond a certain height (varying with the local conditions) the top will be blown off since the velocity of the wind increases rapidly with altitude.

It frequently happens that the climate is too arid to support plant life on dunes, or that the dunes themselves are too active. When such conditions exist the dune travels across the country with the prevailing wind, covering everything in its path. Farm lands, buildings, forests, and rivers, offer little resistance (Fig. 1). Desolation reigns supreme in its path. Such movement does not occur rapidly as we are wont to think of speed, but by the relatively slow process of carrying sand grains up the windward side (a, Fig. 2) and dropping them again on the leeward side. Thousands of dollars are spent in some localities in planting sand reeds upon the drifting dunes to stop this movement. When the wind prevails from one direction the dune acquires the characteristic shape indicated in Fig. 2, viz., gentle windward

FIGURE 3.—Wind ripples. These ripples were formed by a wind blowing from right to left. The first and second vegetation zones are shown also. (Caldwell.)

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FIGURE 4.—Roots growing from the trunks of cottonwood trees and exposed by migration of the dune. (Fuller.)

and steep leeward slopes. Since the lee slope is protected from the wind it will be just as steep as loose sand can stand. This shape is represented in miniature by the wind ripples frequently seen on a sandy surface (Fig. 3).

If a dune acquires a protective covering of vegetation it will stop traveling and become stable. But when for any reason plant life ceases to protect it, or man carelessly cuts into it, the wind soon attacks the exposed part and *dune-destruction* and

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movement begins. As pointed out above many plants are able to sustain themselves in competition with a growing dune, but they are helpless when a dune is blown away from around them. The roots which were sent out from the trunk are exposed to the air and the tree perishes. Examples, as shown in Figure 4, are common in a dune region where trees grow. Plant life, however, especially the sand reed, resists dune-destruction and remnants of the dune may be found held together by the closely woven root system of the plant (Fig. 5).

Aside from dune-building and dune-destroying wind-blown sand acts like a "sand-blast" and frequently cuts the bark from the windward side of tender branches and shrubs; erodes away the softer parts of tree trunks; polishes rocks and pebbles, or the bones of some unfortunate animal that has perished in the sand; or carves the exposed rock ledges into many fantastic forms.

Plant Life.

The plant life of a dune area will vary with the prevailing climate hence one description will fit only the specific case. If the south end of Lake Michigan be taken as an illustration the principal floral units are as follows: The beach is without vegetation, as the sand is alternately dry and wet and is affected severe-

Figure 5.—Sand reed and other vegetation acting as sand-binders and preventing dune migration. (Fuller.)

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FIGURE 6.—Dune advancing over a forest. The tops of partially buried trees may be seen in the middle background. (Caldwell.)

ly by ice action during the winter. No dunes occupy this area as there is no vegetation to start them, and the wave and ice action are severe enough to destroy any that get started. The second belt from the lake is occupied mostly by annual plants and small dunes may be built here. Young cottonwood and sand reed seedlings are common. The third belt includes the active dune building area, and the characteristic plants are the sand reed, cottonwood, dogwood, willow, balsam, aspen, and sandcherry. The cottonwood, willow, and dogwood usually start in the wet sand near the base of the dune and grow upward with the growth of the dune, constantly keeping their upper parts open to the light. When the dune becomes more stable and shade is cast by the moving-dune plants, the pine seedlings are able to germinate, and the jackpine, whitepine, red cedar, and juniper become characteristic. This stability leads to the fourth stage, as humus is allowed to accumulate and oaks thrive. In the oak and pine forest may be found such common plants as bearberry, grasses and sedges, wild rose, New Jersey tea, prickly pear, mosses, strawberry, black haw, etc. It is evident, therefore, that four com-

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paratively distinct vegetation belts or zones exist in this region. The facts and principles illustrated in this specific case can be adapted to other localities.

Human Relations.

The influence of a sand dune region upon man is both negative and positive. If a man's good farm land lies in the lee of a dune area it may be entirely buried by the advancing sand, his farm buildings and fences may be covered and he will be forced to seek a home elsewhere. The sand area itself is of low agricultural value and will support only a very sparse and nomadic population. Further, the drifting sand is very destructive to forests as few trees can survive even a partial burial and the densest forest is no obstacle to an advancing dune (Fig. 6). Railroads, wagon roads, and streams traversing a dune area have to be guarded constantly if they are to remain in service. Regions of wind blown sand, therefore, offer little inducement to human occupation. However, dune areas if favorably situated may be very valuable. Such is the case with the dune area at the south end of Lake Michigan. Here the sand is used extensively for railroad grading, concrete and brick manufacture. The region itself is the site of many manufacturing plants, towns, and cities. This value, of course, is not due to the presence of the sand but to the location. As previously pointed out dunes may be made stable by planting them with suitable vegetation, and where the climate is favorable they may be converted into good pasture land and forest reserves. In general, the latter is probably the most important way in which dune areas can be made useful to man.

He who knows the most, he who knows what sweets and virtues are in the ground, the waters, the plants, the heavens, and how to come at these enchantments is the rich and royal man.—*Emerson.*

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A Trip to the Sand Dunes

FLORENCE VALENTINE.

[See note at beginning of previous article.]

One crisp Saturday morning our teacher of physiography, took the class on a field trip. We took the train to a small town about half a mile from the sand dunes at the lower end of Lake Michigan. The first question one asks is what the dune is composed of and where it gets its material. It is a mound of sand, the material of which is blown up in small quantities from the lake beach by the wind. The sand is weathered rock washed by the lake currents from the bluffs upon the western shore to the southern shore of the lake.

The sand does not remain long upon the beach but is constantly moving inland. It is rolled or blown by the wind close to the ground until it meets with some obstacle. A fence or tree trunk often causes the sand to lodge, though a small shrub is the most common. Here the sand lodges and a small mound is formed. The sand is then rolled up the leeward side, which is gradual and falls upon the windward, standing as high as sand will stand. The sand is so fine that even the wind leaves its imprint upon it, in miniature dunes which are sand waves with windward and leeward slopes. This may be seen in Figure 1 to a small degree.

The plant life on a sand dune area is more varied and fascinating than one would suppose possible. Upon the shore of the lake there are no vegetables whatsoever, due to the washing of the water and temperature of the ground in that vicinity. A short distance inland there is a sand reed which seems to be native to this region. There are two varieties of this reed, their difference lying in the direction in which their roots grow. The one grows perpendicular, holding the sand from the very base of the small mound, the other spreading its roots wide holding the sand upon the surface compact. One of these reeds is illustrated in Figure 2.

Thus far we have seen only the beginnings of dunes or small mounds. These mounds grow inland in proportion to their height until they become dunes. As they recede from the lake region the vegetation becomes more plentiful and on the dune flourish dogwood and cottonwood. Although the dogwood is but a shrub, it attains the height of a well grown tree and is not so often buried in the sand as is the cottonwood. This special variety of vegetation has a peculiar power which is particularly necessary to plant life on the ever growing sand dune. As the

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FIGURE 1.*—Top of dune held in place by vegetation. Wind ripples and exposed roots are shown in the foreground.

dune grows in height it covers the trunks of the trees and shrubs which we find on them. The tree fights to maintain life, and in order to live it must keep its head above the top of the dune. To enable it to gain this end, nature has provided it with the power of sending forth new roots from that part of the trunk which has been buried, giving the tree a new start. The tree must not only keep its top branches above the sand in order to retain life, but also the sand about its roots is equally as essential. In Figure 3 we have an illustration of the roots sent forth from the tree trunk. The roots of the plant life tend greatly to hold the sand about them more or less compact, but are not sufficient proof, however,

FIGURE 2.—A sand reed holding the remnant of a dune in place.

* Illustrations are from photographs made by the student writing this article.

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FIGURE 3.—Roots growing from trunk of a cottonwood tree and exposed by migration of the dune.

against the driving wind. And in time the dune moves on leaving the bared roots as in Figure 3.

Upon the leeward side of the dune there are distinct tree lines of Pine, Willow, Juniper and others, which may be seen in Figure 4 to some extent. Across the river is a grove of sturdy oak trees and several varieties of berries and wild grapes.

The vegetation on sand dunes should always be encouraged

FIGURE 4.—Advance of dune over Calumet River showing moving dunes on the left and stable forest covered dunes on the right.

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for without it the dunes move rapidly. The sand dune is crossing the river at one place (Fig. 4) and at another has dammed it forcing an underground outlet to the lake. If the plant life upon the sand area just described were to be removed, it would cause great destruction, to the town and railroad near by.

Sand dunes influence the interests of man though little for his good. They may furnish material for making mortar with which to construct buildings, and grading railroads. The laying-out of towns and railroads are greatly influenced by the sand dune region. In this case we found the town and railroad situated about half a mile from the immediate dunes. The side walks running for a short distance out of the town in the direction of the lake, are but half of their original width owing to the wide distribution of sand. Other dunes in the course of migration have buried railroads, forests, and towns in which the loss of property was considerable.

There are a few less important but interesting facts in connection with the sand region. We found the sand in one place deposited in layers, and learned that when such sand became cemented it became sandstone. The constant wind blown sand upon the trees tend to strip them of their bark and if dead, to polish them smooth. Stones also, are polished and sharp edges worn upon them in this manner. Another interesting feature of the sand dune and its vegetation is that it serves all of one's needs for a fire to prepare a good meal. The dead wood served to build the fire quickly and the slim twigs which were polished by weathering made excellent forks for roasting sausages and marshmallows. The position of the dunes in ranges made the finding of a sheltered spot from the cold lake breeze very easy, and the lack of luxuriant undergrowth prevents conflagration. The trip was a very interesting one and after learning all that was to be gained by exploring the dunes we enjoyed a social hour, about the camp fire.

The Editor will pay $1.00 for each copy of VOL. 1, No. 1 sent him.

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Correlating Tree Study with Other Kindergarten and Primary Grade Subjects

EDITH R. MOSHER.

The curriculum of our ordinary schools is already well filled, but tree study may be taken up as a part of other established courses. It fits admirably and logically into many of these, making them more attractive and giving them vital interest, thus correlating the lessons with the activities of the outside world. These precious moments given may result in a systematic, progressive unfolding of tree knowledge.

Every teacher should gladly welcome the subject. Trees are the most numerous of all objects, and no other study so readily places within the teacher's grasp that with which to quench the child's insatiable thirst for variety. It has to do with a thrilling, throbbing, beautiful life, and brings into the schoolroom the sweet and fragrant air blown from God's great out-of-doors. Indeed, it seems to me quite impossible to teach little children without the aid of tree study.

The various phases of the subject which invite research are almost limitless, and seem to unite to inspire suggestions of all sorts of uses in the schoolroom, not only for lessons, but for busy work and guessing games, their uses depending only upon the interest, ingenuity, and skill of the teacher.

TREE STUDIES WITHOUT EXTRA TIME.

There is perhaps no subject in which such rapid advancement can be made with a minimum amount of supervision and time.

During the regular morning exercises some song, rhyme, or quotation may be learned about a particular tree.

There are wonderful tales about trees, for the story hour:

How they scatter their seeds.
How they protect their buds in winter.
Stories of the carpenter and what he makes of wood.
Stories of toys, household articles, and paper making.
Of lumbering, and building houses and bridges and railroads and boats.
Stories of the log from forest to furniture.
From oak tree to armchair.
From the big tree to the tiny shoe peg.
From the tree to the violin or piano.
From summer sunshine to winter's warm fire
The tree home of the birds and the squirrels.
The dream of the old oak tree.

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BASSWOOD SPRIG IN BLOSSOM.

Have a forest museum in which each child can take a personal pride and bring specimens gathered perhaps on the way to school. In this way daily lessons are given by visual impression.

Select a tree near the schoolhouse and encourage the children to watch its growth, and to look at home for a particular tree, and to bring leaves and branches which can be used for decorative purposes around the schoolroom.

Every school should plant trees and learn to care for them, or each class may have its own tree and watch and care for it, and each progressive little tree immediately takes up the important duties of Assistant Instructor in Tree Study.

CORRELATING TREE STUDY WITH LANGUAGE LESSONS.

Language lessons based on the color of the leaves, for instance, afford ample opportunity for the child to express himself.

Stories about when and where the leaves were gathered may be given in short, complete sentences, or in longer and more difficult stories.

Easy sentences may be written upon the board and used for reading lessons.

Older children can write their sentences and stories themselves. Illustrating them with trees and leaves will stimulate interest and originality.

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The child world has much to do with trees, and the child's curiosity and imagination are ever active. Such questions as the following may be asked:

What color are the leaves in summer?
Are they all the same shade of green?
What do the leaves do in summer? In winter?
What color are the leaves in autumn?
Does each tree have its own autumn color? What color do hickories turn?
Do you know any leaves that do not change color? What do we call them?

PISTILLATE SPRAY OF SCOTCH PINE.

If the leaves remain on the tree all winter, do they ever fall off?
Why do you like the trees?
Would you like to have your dooryard without trees?
Do you like to go to the woods to play?
Does the grass grow under the trees just the same as it does out in the sunshine?

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What gifts does the tree bring to us?

What does the tree give you to eat? Name the fruits. Name the nuts.

To how many of God's creatures does the tree give food? Does the tree help them in any other way?

What do you see in this room that the tree gives to us?

Name everything in the dining room at home that the tree gives to you.

Tell me all the things you see on the way to school that the tree gives to you.

Name all the things that you use in one day that the tree gives to you.

Name all the things that you used when you went away from home on a trip that the tree gives to you.

Name all the things you ever rode in that are made of wood.

What musical instruments can you think of that are made of wood?

Name five things that you like best that are made of wood.

Name five things that you use most that are made of wood.

What things does the baby use that are made of wood?

What things does grandpa use that are made of wood?

In introducing tree subjects as language lessons, we should keep within the child's knowledge and use his interest simply as a basis for language work. Criticism should never be such as to make him conscious that he is having a language lesson. Tree study, however, offers unlimited selection of subjects by which to develop spontaneous expression.

The teacher should have some fundamental facts at her disposal which will interest the child and lead him into accurate channels of thought. For this she must depend largely upon books especially prepared for the instruction of children. The language lesson can then fulfill its double mission in carrying with it some little important tree study information.

Correlating Tree Study With Drawing.

The correlation of nature-study and drawing is so natural and inevitable that the pupil need not suspect that he is having a drawing lesson. When he is interested in any subject he enjoys illustrating his observations—it is a natural self-expression. The picture of what he sees is in his mind and his imitative impulse prompts him to tell you about it by making another picture, and he draws before he knows it.

The making of drawings should always be encouraged for illustrating what is observed, as a graphic presentation is far better than a long description of natural objects.

Everything about the tree inspires a drawing: the tree outlined against the sky; the leaves in spring, summer and autumn; the buds and blossoms; and the various fruits. Nature surely

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furnishes the source of supplies for developing the artistic sense.

We have the beauty, forms and conventional designs, and the natural studies in form and color which are always ready for a drawing lesson.

Here, where nature bestows her abundance in fascinating variety, the teacher, in order to give to the lesson its greatest value, should have at hand the basis of scientific fact, which is a constant quantity. This can be found in books prepared especially for the subject. We then have a study not only in artistic effect, but our drawing is accurately based upon fact, and is in addition a valuable tree-study lesson.

Tree Study by Blackboard Illustration.

The importance of blackboard drawings can hardly be overestimated.

Visual impressions are constant educators and fix the concept permanently in the mind of the child.

In my own experience, I was continually using tree materials for decorating the blackboard. In the spring it is the buds and blossoms, and in autumn the pretty colored leaves—whatever the children bring that can be used. In order to make a complete and instructive lesson, you wish to show more of the life history than is given in the branch brought in. Scientific drawings are heavy with detail and lacking in artistic effect. Even the knowledge of what a characteristic leaf is reaches quite into the realm of science—far beyond the province of the regular teacher. What is needed is an artistic drawing, simple in outline, accurate in the essentials that are important to the primary teacher, together with a statement of the elementary details within the comprehension of children. The drawing can then be a valuable lesson in visual instruction.

We may be making a border, or decorating the blackboard at the back of the room which can't be used for lessons, or ornamenting a calendar, or making use of a leaf in the language or number lesson—in whatever way we use the tree material, we are giving to the child a mental concept, and if clear and accurate, our drawing stands as a silent educator, giving its lesson of lasting value.

Tree Study by Visual Instruction.

The teacher can accomplish much by appreciating the value of visual instruction. There should be an effort to give single ideas so as not to confuse. If the lesson is on the Red Maple, the Red Maple should be used to the exclusion of all other trees

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CATALPA BLOSSOMS.

until the children have the concept firmly fixed. Perhaps for a week the Red Maple leaves can be used for decorating the schoolroom. The children should be encouraged to bring in something from the Red Maple, to tell something about the Red Maple. The story should be about the Red Maple. The drawings should be of the Red Maple leaves. The leaves can be mounted on cardboard and placed around the room. The children can mount their own specimens, and with the main characteristic noted or an appropriate quotation, it can be one page of the leaf portfolio for the child to carry home. The Red Maple leaf can be outlined on cardboard and used for the sewing lesson, or colored with crayon. The blackboard decorations should be of the Red Maple leaves.

In this way the concept of the Red Maple is firmly fixed with little or no botanical information for the child; but it is important that the teacher have the typical Red Maple leaf in mind, and while the fascination is in the variety, it should be the constant aim of the teacher to lead the child's thought into accurate channels and to fix, as a permanent concept, the characteristic Red Maple leaf.

TREE STUDY AS A REWARD OF MERIT.

Nature-study offers such an excellent *reward of merit* system. The entire school will do better work during the day in

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anticipation of gaining a few extra moments for the nature-study lesson.

While other lessons are looked upon as more or less of a task, and the child is sometimes kept after school in punishment to learn his lesson, the tree study can be given as a reward for good work.

It helps in discipline since it keeps the child interested and gives him something to do. It fills the extra moments by supplying busy work for idle fingers. After he has finished his allotted task—and I have in mind how my children one by one would sit back in position with expectant eyes fastened for approval upon the teacher, well knowing that something interesting was in store for those who applied themselves well and finished early—he may go to the table and sort piles of pretty autumn leaves, or with colored pegs make the colored maple leaf, or with pencil and paper make a border design from the large outline maple leaf upon the blackboard, or write a short story of yesterday's lesson illustrating it with drawings of leaves or fruit.

With the trees there is always inspiration for delightful lesson surprises, which are like little prize packages for the children; and their reward for hope and expectation is a small bit of tree knowledge.

Tree Study as a Recreation Lesson.

The tree lesson may be reserved for that time of day when the pupils are weary and restless and the hours drag. At such a moment it affords immediate relief. The lesson can be short; at least one point should be learned and the appetite whetted.

If rightly presented the subject awakens the interest of the pupil, and this should be sustained throughout the entire course. Implanted deep within the child is the instinct to investigate—to get through his own experience a knowledge of his environment—and intuitively the teacher will make at least some use of materials brought in by the pupils.

The child should never be made to *learn* nature-study. He has a natural curiosity and interest in everything he sees, and this activity law of his growth is utilized. He feels a joy in acquiring knowledge—in making a discovery; and there is in tree study a constant, changeful contact with his environment which is ever operative; so that unless the lesson is spoiled in the teaching, the children will always be enthusiastic.

It is a recreation, an outing, an excursion into fairyland, if you please, from which we return refreshed to regular lessons.

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Book Reviews

The Wilderness of the North Pacific Coast Islands. By Charles Sheldon. Charles Scribner's Sons, New York. Pages XVI+246, $2.00.

This is a narrative of experiences while exploring and hunting for wapati, caribou and bear on the large islands off the coast of British Columbia and Alaska. The sportsman will find some thrilling tales, especially of the bear hunts, but the naturalist will be charmed mostly by the excellent descriptions of the country and the splendid photographs that illustrate the book. The nature lover will appreciate this sentiment. "I was again installed in the wilderness; a sense of deep contentment stole over me as I sat looking out on the calm water of the beautiful bay. . . . The feeling of freedom cast a soothing spell over me as I fell asleep that night while rain-drops were pattering against the canvas."

A Laboratory Manual of Agriculture for Secondary Schools. By Leland E. Call and E. G. Schafer, both of Kansas State Agricultural College. The Macmillan Co. Pages XIV+344. $0.90.

This seems a very serviceable manual of directions for actual work in the elements of scientific agriculture. Some 65 pages are given to soils, 20 to germination, 84 to studies of corn, rye, barley, etc., 50 pages to stock judging. A few pages are devoted to the plow and corn planter. The exercises are arranged seasonally. Blank pages are provided for notes and records and score cards are printed to be filled in by the student. The chapter on tree identification might as well be omitted. It simply tells the pupil to go to the park or woods and identify all species possible. It makes no suggestions of books to be used or other aids to identification.

Wild Life and the Camera. By A. Radclyffe Dugmore. J. B. Lippincott Co., Philadelphia. 332 pages.

Those who know Dugmore's previous volumes will anticipate that there will be some charming sketches of bird life in this one. "My Chickadee Friends" and "The Warbler Family" are chapter titles of bits of description quite as good as anything Dugmore has done. But this book oversteps the bounds of birdland and we have results of camera studies of larger game and of some game fish. The record of what the author evidently regards as his chief achievement is given under the title of "The

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Caribou Migration in Newfoundland." It is an excellent example of what a sportsman can accomplish with a camera. It represents the achievement of six years of effort, five fruitless, one finally successful. The admirable pictures are so infinitely superior to the caricatures that illustrate so many books on animal life, pictures of an animal first killed by a rifle and then photographed either as a carcass or stiffly-posed in a propped-up attitude. Speaking of the caribou, he says, "The leads or roads which they follow have been in use year after year, perhaps for hundreds or thousands of years, for in many places deep furrows are worn in the rocks by the hoofs of the countless thousands." There are suggestive chapters on methods in bird and animal photography and on camping out.

Biology, an Introductory Study. By Herbert W. Conn. Pages X+425, Silver, Burdett & Co.

This book seems like almost an ideal text to put into a high school course. It gives in an entertaining way, at the same time with scientific accuracy, the main themes of modern biology. One misses with gratitude the stereotyped morphological treatment of plants and animals,—the customary university and college course suitably attenuated for high school purposes. Directions are given for laboratory work on a few types studied and the attempt is to present the reactions and functions of the organisms and to point out the chief applications to human problems both social and industrial. Dr. Conn is to be congratulated on his ability to exclude the non-essentials.

Plant and Animal Children and How They Grow. By Ellen Torrele. 230 pages. D. C. Heath & Co.

This book is written especially for the pupils of the elementary schools. It aims to make clear the ideas of evolution, heredity, variation, effect of environment, and the evolution of sex, without once mentioning these names. In this it is a departure from that tradition in education which has held that such ideas are the exclusive prerogative of the college-bred. There is no doubt that children are greatly interested in the study of plant and animal life and are quite able to comprehend the subject matter of botany and zoölogy, as the author states in her preface, but it is quite questionable how much the average teacher will be able to get out of the class with this book as a text discussing such forms as the green algae, fungae, marchantia and its reproduction, amoeba and its allies, hydra, etc. The work

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on the higher plants and animals is presented simply and should be of service to the average teacher although the reviewer is inclined to think that the same matter given from the functional view-point would be better than when thrown into systematic form. However, we may welcome all these experiments in the pedagogy of plants and animals in our attempts to find the really good methods of procedure.

School Agricultural. By Milo Wood. Pages XV+339, Orange Judd Co.

This book is intended as a text for rural and graded schools and it seems to meet the requirements as such about as well as any agricultural text that has yet appeared. Some fifty pages are devoted to soils, including drainage, irrigation and tillage; plants occupy 100 pages; animals 145; then there are chapters on farm implements, roads, beautifying the home and school grounds and three pages on country life. This book is to be commended for even this brief chapter for most of these texts are concerned exclusively with the means of getting a livelihood rather than stimulating the child to think along the lines of improvement in the problems of rural living. Fifty pages are given up to a valuable appendix containing reference tables on nutrients, weeds, fruits, insecticides and fungicides.

The Birds' Convention. By Harriet Williams Myers. 81 pages. Western Publishing Co., Los Angeles, Calif.

This is a report of the first annual convention of the birds called because "our human brothers hold meetings which they call conventions." It jars the nerves of the average naturalist to have birds talking together, making sage remarks and gossiping. The child apparently sees little incongruous in this. The proceedings of this "convention" impart considerable bird lore incidentally, and the report is accompanied by numerous very good illustrations from photographs by the author, who is Secretary of the California Audubon Society.

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DEVOTED PRIMARILY TO ALL SCIENTIFIC STUDIES OF NATURE IN ELEMENTARY SCHOOLS

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VOL. 9 MARCH, 1913. NO. 3

The Song Sparrow*

HENRY VAN DYKE.

There is a bird I know so well,
It seems as if he must have sung
Beside my crib when I was young;
Before I knew the way to spell
The name of even the smallest bird
His gentle-joyful song I heard.
Now see if you can tell, my dear,
What bird it is that, every year,
Sings "Sweet—sweet—sweet—very merry cheer."

He comes in March, when winds are strong,
And snow returns to hide the earth;
But still he warms his heart with mirth,
And waits for May. He lingers long
While flowers fade; and every day
Repeats his small, contented lay:
As if to say, we need not fear
The season's change, if love is here
With "Sweet—sweet—sweet—very merry cheer."

He does not wear a Jacob's coat
Of many colors, smart and gay;
His suit is quaker brown and gray,
With dark patches at the throat.

*From John Burrough's Songs of Nature, McClure, Phillips & Co.

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And yet of all the well dressed throng
Not one can sing so brave a song.
It makes the pride of looks appear
A vain and foolish thing, to hear
His "Sweet—sweet—sweet—very merry cheer."

A lofty place he does not love,
But sits by choice, and well at ease,
In hedges, and in little trees
That stretch their tender arms above
The meadow-brook; and there he sings
Till all the field with pleasure rings;
And so he tells in every ear,
That lowly homes to heaven are near
In "Sweet—sweet—sweet—very merry cheer."

I like the tune, I like the words;
They seem so true, so free from art,
So friendly, and so full of heart,
That if but one of all the birds
Could be my comrade everywhere,
My little brother of the air,
This is the one I'd choose, my dear,
Because he'd bless me every year
With "Sweet—sweet—sweet—very merry cheer."

One Adjustment of the School Garden to the School Year

LEWIS M. DOUGAN.

At the Henry Shaw public school in St. Louis, the year ends about June 15th and begins again on the first Tuesday in September. Between these dates, for two and a half months of the best of the growing season, the pupils are widely scattered and regularity of attendance upon garden work is practically impossible. Some are out of town, some are employed during the hours when the garden needs them, and there are some who are indifferent. So, during vacation, our garden work as done by classes is suspended. I mention classes because under our conditions it seems best for the children to work in groups of twenty-five or fifty at a common plot in all grades below the sixth. By this method we give some garden practice to a larger

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number than would otherwise be practicable and avoid the waste and confusion which would result if the forty per cent who do not understand English very well were to be given individual gardens. The spring thus automatically ended on June 15th may be said to open April 3rd, the average date of our last killing frost, leaving us a growing season of approximately ten weeks. Some early springs, like that of 1911, may lengthen the season by a fortnight or more, and some backward ones, like that of 1912, may shorten it by an equal period; but both these seasons were exceptional and we may reckon three-score days and ten as our allotted time for spring gardening. Within this period, we can safely bring to table stage, peas, string beans, lettuce, beets, onions from sets, radishes and turnips. Last year our beets and turnips were not sufficiently mature at the close of the season, but we shall find a way to hasten their growth during another such season by improving the condition of the soil or by the use of a hot bed for starting the plants. Meanwhile, we shall further experiment with varieties.

With the gathering of the above crops, the boys spade the ground and plant it in sweet corn and pumpkins. These are cared for during the summer by volunteer boys and the gardener in charge of the grounds. Corn is so well suited to our soil and summer heat that it is easily grown if sufficiently watered. In case of drouth following planting, city water is used for starting the crop. At the last hoeing, turnips are sown wherever the corn has failed. On the opening of school in September the corn is nearly ready for picking and later in the month the pupils have green corn to take home, besides some problems in arithmetic and botany. Our first killing frost does not occur on the average until October 27th, and never, according to the records, before September 30th, so that we have ample time for growing corn after June 15th. We are, also, practically sure of time to ripen our Thanksgiving pie material, but the tender vines are sure indicators of the advent of the first serious frost. The pumpkins we allow to remain till the ground freezes somewhat—generally about December 1st—and then the garden is spaded for the winter's freezing.

Out of three years' experience, we find the long summer vacation is a smaller obstacle than it seems in the way of school gardening. As a stimulus to the study of specific conditions it is a help. It forces us to a study of the time required by different plants and different varieties to reach a given stage; it makes us put our ground in better condition for seed germination in

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cool weather; and it makes us test our seeds indoors to insure against delay and loss after planting. In a word, it has made us better gardeners than we might otherwise have been under easier conditions.

Agriculture for Rural Schools

ARTHUR D. CROMWELL.

Why should we teach Agriculture in the rural schools?

Because:—

The whole child and not his head only should be educated.

We should teach more in terms of the child's life.

We should go from the known to the unknown and abstract.

We should enrich the course of study, by teaching more of the concrete, by making our school problems the child's life problems, and by giving motive to school work.

We should give strength through doing something worth while.

We should teach Agriculture because it makes for better citizenship, economically, intellectually and morally.

SOME PRINCIPLES OF TEACHING SCHOOL AGRICULTURE.

School Agriculture is the study of how to make a living in the country. This living is partly industrial or economic and partly social; therefore the study of school Agriculture should include both the economic and social sides of life in the country.

We should teach from things largely instead of from books.

We should prefer "bulletins" to books for bulletins are apt to be nearer up-to-date and may be so selected as to be applicable.

We should teach things to do instead of things to know.

We should teach subjects in their seasonal sequence or follow the dominant home or community interests. This enables us to get material, to get interest and co-operation of parents, and to teach children to do things in a systematic and orderly way.

We should have pupils make "booklets" on the lessons or subjects. The "booklets" enable us to make sure that the pupils understand clearly, correlate the work with other subjects; such as writing, spelling, arithmetic, geography, etc. The "booklets" enable us to make sure that the pupils organize their knowledge. Then, too, the "booklets" make attractive records of the work. These records may be used for school exhibits at teachers' institutes, farmers' institutes, grange meetings, county fairs, etc.

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A COURSE OF STUDY FOR THE NORTH CENTRAL STATES.

SEASONAL SEQUENCE.

September and October.—Seed selection, especially seed corn; birds; insects; weeds; the plant and how it grows; plant breeding, especially potato.

November and December.—Housing farm crops and animals; feeds and feeding; stock judging; scoring corn, fruit, domestic science products, and potatoes.

January and February.—Care of farm animals; ventilation; dairying; farm acounts; farm machinery; seed testing; repair of farm equipment.

March and April.—Field management; crop rotation; poultry; care of vegetables and eggs; landscaping; gardening; weeds; fruit growing; flies and mosquitoes.

It will be noticed that by the above course, we study gathering seed corn when that is the dominant home interest, and then we learn to score corn at the time when the farmers are trying to pick corn for the various corn shows. Again we study weeds in both fall and spring for there is something to do in both fall and spring in order to keep down weeds. Birds may well have a place in our course both fall and spring. If we are to improve our potato seed, we must pick potatoes from those hills that have five or more good sized and good shaped potatoes in them. Hence plant breeding, especially potato breeding, must come in the fall.

The Small Crustaceans

FIRST PAPER.

W. C. ALLEE.

The crustaceans are to the water of our small lakes and ponds what the insects are to the air. The two groups are closely related, both belonging to the phylum Arthropoda; that is, to the group of animals that have a hard external covering, usually divided into easily apparent segments, and that have jointed appendages. The crustaceans may be distinguished from the insects because they have two pairs of antennae in front of the mouth while the insects have but one pair. These differences may be readily seen by examining an ordinary crayfish, which is the best known and largest of our fresh water crustaceans, and comparing the antennae with those of a grasshopper. This paper deals with certain facts concerning the small crustaceans (crayfish excluded) that may be of use to the amateur collector.

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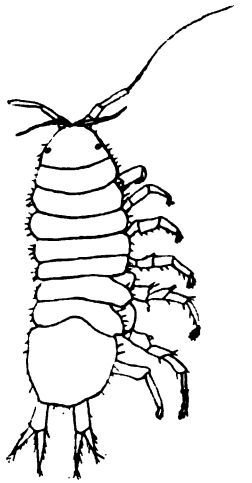

FIGURE 1.—The Isopod, Asellus communis ♀ × 4.

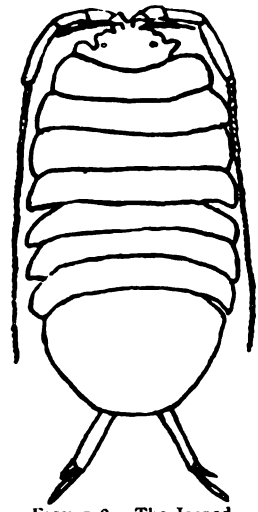

FIGURE 2.—The Isopod, Mancasellus Danielsii. (After Richardson.) × 3½.

ISOPODS.

Isopods (Fig. 1 and 2) are commonly known as "sow bugs" or "pill bugs." The land representatives of the group are quite common and are usually known, since they occur in damp cellars, in green houses or under damp boards. Water isopods resemble their land relatives in a general way and will be immediately recognized if one is acquainted with the land isopods. The name "sow bugs" comes from the fact that the female deposits her eggs in a brood pouch on the under side of the thorax. This pouch often gets so large that the animals are scarcely able to walk. Here the young hatch and are carried until they are about one twenty-fifth of an inch long, when they are liberated as small white animals much like their parent in essential features. Usually about forty young are liberated at a time, although two hundred have been taken from a single brood pouch. Isopods are called "pill bugs" because, in common with amphipods, and many other animals, they have the habit of rolling into a "pill" when disturbed and lying quietly until the effect of the shock wears away.

Isopods are flattened as if a weight had been placed on their backs. The thorax (Fig. 1) bears seven pairs of legs that are very similar and hence the name iso-pod, meaning like—or similar —footed.

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The thorax is plainly segmented, since the hard chitonous covering is divided between each segment. The abdomen is also segmented but this is not visible on the upper side, since the segments are fused together and covered by a single plate. The gills are located on the under or ventral side of the abdomen and are covered by large plates which keep up a continual waving motion. Two branched appendages called uropods extend behind the abdomen. These are sensitive to touch and thus serve the same purpose as the antennae. Hairs are scattered all over the body and these are also sensitive. A dark median line is often visible, extending the full length of the body. This is the alimentary canal and its color is due to food that has been recently taken.

The isopods of the Chicago area are brown with a rather faint color pattern. The adults vary in length from two-fifths to two-thirds of an inch, depending upon the conditions in which the animals have been living. There are only two species found near Chicago. Their distinguishing characters follow:

1. Extremely flattened wide isopods with the upper covering (carapace) extending far beyond the body proper and having a well defined reddish color pattern on a darker background.

MANCASELLUS DANIELSII (FIG. 2).

2. Less flattened, narrower isopods, with the carapace extending only a little beyond the body; color markings faint and of a dull cream color on the smoke colored background.

ASELLUS COMMUNIS (Fig. 1).

Of the two species, Asellus communis is the more widely distributed. This is true not only in the Chicago area but in all of the northeastern states. The males of this species are distinctly larger than the females and have a different body form. Usually the females are almost as broad at the anterior end of the thorax as at the posterior end, while the males taper gradually from the extreme posterior end to the head. This distinction is not so marked in the other species. Asellus is abundant in temporary and permanent ponds and in small streams and is present in protected embayments in small lakes. It is most abundant in the spring in the temporary roadside ponds which have the bottom thickly covered with leaves. In the early spring the isopods may be collected by the hundreds from these ponds by dipping up the wet leaves with any close meshed net and picking out the isopods with the fingers. Later in the season as the ponds dry the Aselli retire under the leaves

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and find there enough moisture to keep alive until the following rainy season.

Isopods do not occur in young ponds that have sandy bottoms. But whenever the bottom has begun to be enmeshed by interlacing roots, Aselli appear and once present they remain until the pond is reduced to a mere vernal pool corresponding to the roadside ditches just mentioned. They are most abundant, however, in grassy bottomed ponds that contain water a greater part of the year. In lakes they are limited to the pond-like embayments where conditions are essentially the same as in a true bond.

The Aselli found in streams average from one-eighth to one-sixth of an inch longer than those of ponds, and are more vigorous in their reactions. They are most common in those streams having a slight sewerage contamination but even then they do not extend along the entire stream, but are most abundant in the pools among the leaves or other debris that protects them from the sweep of the current. They are common in small brooks that alternate pools and rapids. They also occur in streams that are twenty feet or more across. Isopods are scarce in the larger streams about Chicago. Asellus is also present in old base-leveled rivers, but here pond plants grow along the margin and it is obvious that the conditions approach those of ponds. Asellus inhabits one other type of habitat, that is the spring-fed marsh. In such a water cress marsh near Cary, Ill., they are abundant although smaller than those found in ponds.

Mancasellus, the extremely flattened isopod, is found wherever Asellus occurs except it is not present in the larger, rapid-flowing streams. It is reported only from small grassy brooks near the Naval Station at Great Lakes, Ill. Neither is this form found in the small summer-dry ponds of this locality. In general it is more limited to the grassy regions of the ponds than is Asellus.

The breeding season of the isopods begins in the early spring as soon as the ice leaves the water and continues until about the middle of July. More than one brood is brought forth by the same female in one season. Many adults die at the close of the breeding season, although some of them live over another winter.

The isopods are negative to direct sunlight; that is, they avoid it and collect in dark areas or in regions of faint light. Isopods kept in aquaria will be found wandering around over the bottom at night, while in the day time they retire under leaves and into crannies. In ponds containing vegetation the isopods are nearer

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the surface at night and on rainy days than they are in bright sunlight. This means that there is a daily vertical migration that depends, in part, at least, on light conditions. One other factor helps cause them to collect under leaves in the day time,—the fact that they are positive to touch stimuli. This means that, other things being equal, the isopods will come to rest where they can get most of the surface of their body in contact with some object. In pans they collect in corners; in ponds they are under leaves or in the hollow stalk of a decaying plant. In this respect Mancasellus shows an interesting reaction. When the animals are brought into the laboratory they crawl up along the edge of the containing vessel (other than smooth glass) until they are one, two, or even three inches out of the water, and often remain hanging there until they die of suffocation.

Both species of isopods are easily kept alive and in good condition in the school room. Pint Mason jars are very convenient for transferring isopods or any other small water animals from the field. The jar should be filled with water from the place in which the animals are taken and some of the live or decaying plants on which the isopods are found should be added. If possible stream isopods should be kept in running water. When this is impracticable they may be kept in standing water providing that at first it is changed frequently. After a time the isopods may be acclimated to unchanged water, if the transition is made gradually. A little soil and a few dead leaves, preferably those that have been taken from a small pool, should be placed with the isopods to furnish them shelter and food.

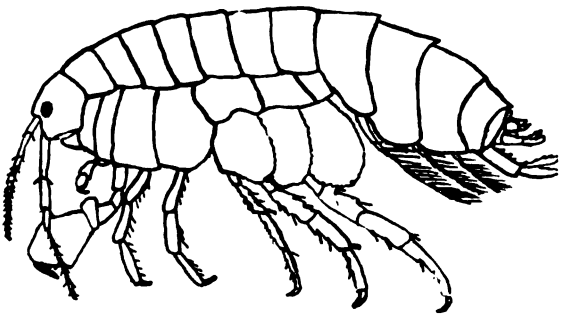

FIGURE 3.—An Amphipod. (After Emerton.) ♂ × 4.

AMPHIPODS.

Amphipods (Fig. 3) are also flattened crustaceans but unlike the isopods they are laterally compressed. In other words, the

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amphipods are flattened as if they had been placed with their sides against the jaws of a vise and pressure applied. They also differ from isopods in the manner of locomotion; instead of crawling, they usually swim. This swimming is accomplished as in the crayfish by bending the abdomen against the under surface of the thorax and then straightening it. The color varies in these animals more than in isopods. The older animals are a dull brown, while the younger ones are usually a pale whitish green. They may be an inch long, but are more often taken about a quarter of an inch in length.

Nine different species of amphipods occur near Chicago. Two are present only in the deeper parts of Lake Michigan; four other species are found in wells, so that only three species occur in the surface waters. There is no easy way to distinguish these species as was true of the isopods of the region, but the following general characters may help give an idea of the species at hand:

1. Gammarus fasciatus is a stream inhabiting species and is most abundant in small swift-flowing streams. This species usually swims on its side, although at times some individuals will swim ventral side down.

2. Hyallella knickerbockerii occurs most often in slow-flowing but not stagnant streams, as in the Calumet River at Clark Junction, Ind., and in young ponds such as those near Pine, Ind. About fifty per cent of these swim on their side.

3. Eucrangonyx gracilis is found in ponds, especially in old forest ponds such as contain isopods. Thus they are present in the ponds near Hessville, Ind., and in pools in tamarack swamps. These very often swim ventral side downward when first taken and may be distinguished in this way.

The manner of swimming is easily modified by external conditions and is only of value as a suggestion of the species at hand if observed when the amphipods are first taken.

Gammarus is abundant in the city park lagoons, especially among water plants. They are best collected by means of a tow net. This kind of a net is made by fastening a tapering bag made of a good grade of cheese cloth to a round or square wire support. Strings are fastened to the wire in three or four different places and united to one long cord by means of which the net may be drawn. For collecting from a bank it is better to place a stone in the apex; with the aid of this weight the net may be thrown some distance from the bank.

The breeding season of these animals begins as soon as the ice is out of the water in the spring and two or three broods are

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produced each season. The young of all the broods normally live past the first winter, at least; many of them live about eighteen months. As with the isopods, these animals are usually found in shaded water. Thus in Cary Brook hundreds may be taken with a single dipping of a net made under the overhanging bank, while a similar collection from the exposed part of the stream will give only a few individuals. This reaction is in part a negative reaction to light. Like the isopods, the amphipods give a daily vertical migration, coming nearer the surface in the evening and when the weather is cloudy than at noon or on bright days. Amphipods are also strongly positive to tactile stimuli. This is shown by the fact that they are found under gravel grains or burrowing under sand or silt of stream bottoms or among leaves and other vegetation in ponds. In the school room they have a marked tendency to collect in corners of the containing vessel.

Stream amphipods are more sensitive than stream isopods and after collection they should be kept in running water although they can gradually be acclimated to quiet water. Care must be taken to avoid a sudden change of temperature. Aquaria containing amphipods should be provided with a few sprays of water plants, such as elodea, to furnish resting places and food

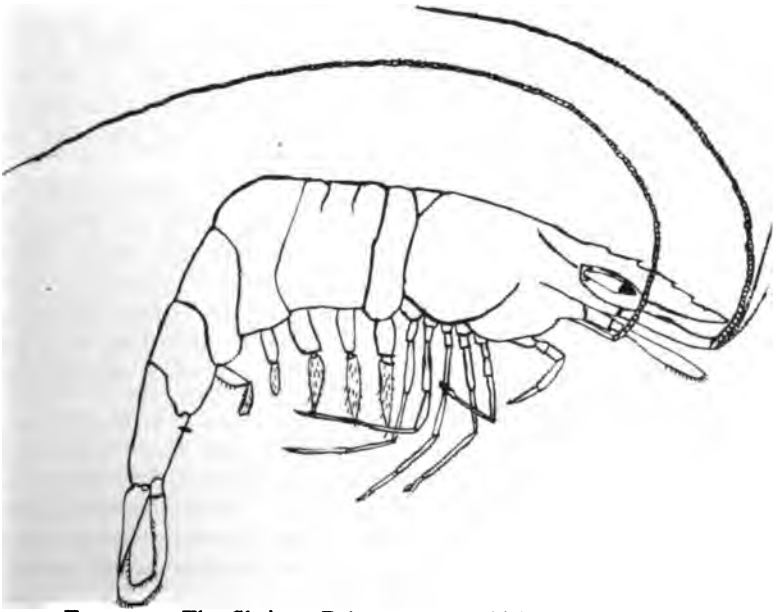

FIGURE 4.—The Shrimp, Palaemonetes. (After Herms.) × 4.

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materials, and should have the bottom covered with sand or silt, whichever was present in the original habitat.

PALAEMONETES.

The shrimp (Palaemonetes, Fig. 4) is most nearly related to the common crayfish of any of the small crustaceans with which this paper deals. The head and thorax are covered by a hard chitonous layer, the carapace, but unlike the crayfish the large pinchers are lacking. Those found in this region are about one to one and a half inches long and usually colorless or a light green color. These shrimps are hard to see in their native habitat because they are so nearly transparent, being almost as clear as the water in which they are found. Palaemonetes is very readily obtained in late spring and summer. They may be seen swimming over the submerged vegetation in water four to five feet deep, where the vegetation reaches close to the surface. They are easily captured with dip, tow, or ordinary minnow nets. Although they may be seen and taken over the vegetation, yet a greater number may be found midway between the surface and bottom among the water plants. Some may be found on the bottom itself. Since the abdomen is well developed they have good powers of springing and readily jump from a shallow net. These shrimps are positive to light of the intensities usually found in nature. Evidently, however, this is not their strongest reaction since they do not crowd to the surface in their native haunts. They are also sensitive to vibrations produced by jarring. This reaction is easily observed if the aquarium containing the shrimps is struck lightly, although, it is also apparent in natural conditions when the water is disturbed.

The shrimps may be kept in the laboratory in running water in jars containing plants like those of their habitat if the temperature does not greatly differ from that in which they were taken. Sand should be used to cover the bottom of the aquarium rather than silt, although when glass jars are used no bottom covering is needed. These animals are rather hard to keep long in good condition in the school room, because they are more sensitive to changes than either isopods or amphipods.

EUBRANCHIPUS.

Eubranchipus or Branchipus (Fig. 5), as it was formerly called, is also known as the fairy shrimp. This common name should not be taken to mean that Eubranchipus is closely allied with the shrimp (Palaemonetes) for the two are really widely separated in their relationships. Eubranchipus is a greenish or

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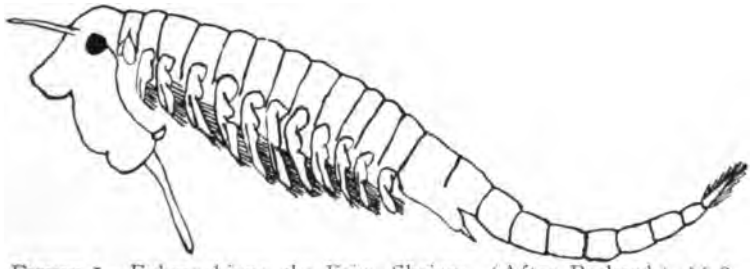

FIGURE 5.—Eubranchipus, the Fairy Shrimp. (After Packard.) × 2.

whitish, semi-transparent crustacean about an inch to an inch and a half long. It is distinguished from Palaemonetes by the absence of the carapace, by the presence of eleven pairs of flattened leaf-like appendages, and by the entire absence of the more usual crustacean appendages such as Palaemonetes possess. Eubranchipus swims about on its back and the waving appendages are one of the first things about it to attract attention. These leaf-like legs of the fairy shrimp are used primarily for breathing purposes.

Eubranchipus is found only in the spring of the year in small summer-dry pools or in ponds that recede greatly in the summer. In order to hatch, the eggs have first to be dried and then frozen. It is supposed these processes break the outer covering of the egg and thus permit entrance of sufficient air and water for growth to start. These fairy shrimps may be found in any of the rather extensive summer-dry ponds or ditches.

Fairy shrimps are positive to light of ordinary intensities, but in spite of this they are found nearer the bottom of ponds in the day than at night. This is because under the influence of light they are positive to gravity while in darkness they are negative to the same gravity stimulus. This reaction may be proven by covering the eyes with shellac and lamp black, upon which treatment the animals swim near the top, although if untreated they would be near the bottom of the container. These animals are more active in light than in shadow as may be seen by placing an animal in a glass dish in sunlight and cutting off the sun's rays from time to time with an opaque object.

Eubranchipus may be easily kept in running tap water or in standing water that is not allowed to become suddenly warm. The temperature should be kept within four or five degrees of that in which the animals were collected.

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The Work of Running Water

GEORGE J. MILLER.

[EDITOR'S NOTE. This article and the one that follows give an outline of the nature-study method of presenting a geography topic by field work and a student's reaction to the same.]

No attempt is made in this article to discuss all phases of the work of running water, but rather (1) to outline what may be studied readily along nearly any river to be found in a climate having sufficient rainfall for a permanent stream, and (2) to suggest a method of studying such work in the field with a class. Each of the topics here discussed may be presented to the student as a problem to be answered by studying the subject in the field. Each phase of the subject may be studied on separate field trips, e. g., a trip to study the work of erosion, the work of deposition, etc., or all phases may be studied at once. The method to be followed will depend upon the ability of the class and the object sought by the instructor. Personally, I have my classes study all phases of the subject at once, and require an organization of the field work in a written report. For field study of running water the small stream is better than a large one.

RUNNING WATER.

What are the sources of running water? How does the water run off? What makes it run? To the first problem the student will answer rainfall (including snow and ice), to the second rivers, and to the third gravity. The study of a small permanent stream during the dry season, however, will convince him of the vital importance of ground-water—springs and seepage—in the maintenance of stream flow. He will learn also that seepage is far more important than springs in maintaining most streams. A tributary of this stream may be dry. If so, he will solve the problems—When does a valley get a permanent stream? Was a valley there before the permanent river? Why do some valleys have streams only when it rains? Why do some streams become dry during the summer? In general, his answer that the water runs off in rivers is correct, but observation during a heavy rain will convince him (1) that some of it runs off in sheets, (2) that slight irregularities in the land surface cause the water to concentrate in the lower places, (3) that these concentrated parts flow faster, erode faster, develope small gullies or "washouts," and (4) that these gullies grow in size with successive rains. May they grow into ravines and large valleys?

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In answering this question he will solve a large percentage of the problems of running water.

Work of Erosion.

Carrying and using sediment. How does a stream get sediment to carry? How does it carry it? What determines the amount of sediment that it *can* carry? How does it utilize the sediment in its work of erosion? What affects the rate of erosion? These are typical problems bearing on this phase of the subject for the student to solve.

The study of a small brook will show (1) the current swinging across the stream channel from the outside of one bend to the outside of the next lower bend, (2) that in striking the bank it cuts away small particles, and (3) that small particles are torn loose from the bed of the stream. If there has been a recent rain the muddy water will suggest that wash from the valley sides is an important source of sediment. In arid localities the wind may be as effective as the rain. In determining these facts the student has noticed (1) that small particles are carried in suspension, (2) larger particles of the same material are rolled along the bottom, (3) that some are picked up, carried a short distance and dropped again. A little experimentation shows him that upward currents are produced by irregularities on the stream's bed and that it is these upward currents that enable a stream to *pick up* and *keep up* sediment heavier than water; that if the coarse material is powdered, so that each particle has a large surface in proportion to its weight, the stream can carry it easily. A little further study shows him that the amount which a stream *can* carry depends upon its velocity, its volume, and the kind of material—coarse vs. fine. It is this material carried by the stream that enables it to *erode*. It is the tool with which the stream works. Delicate plants may be found growing on the bed of a stream which carries no sediment, yet if the stream acquires a load those plants will be destroyed and erosion of the bed and banks will begin. Combining these facts he concludes that the rate of erosion will be affected by (1) the velocity and (2) volume of the stream, (3) the amount and (4) kind of sediment carried, and (5) the character of the material being worn away.

Forming gullies, ravines, valleys.—How does running water develop a valley? The student has learned already how the run-off from a rain collects in a depression and flows off as a streamlet. He will find in the field many examples of the work

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—gullies or "washouts"—accomplished by these little temporary streams. A study of a series of gullies, or the same one at intervals, reveals that (1) they grow in length by head erosion caused by in-flow of rainwater, (2) they become deeper by erosion on their bottom, (3) they grow wider by side-wash from rains, by slumping and creep, (4) they are V-shaped with steep sides and that the sides become less steep as the gully increases in size, and (5) they have a stream only when it rains. Passing from the largest gully with no stream to the ravine with its little brook, he recognizes the ravine as a grown up gully. He also recognizes that it is different. Although still V-shaped, it has a flat bottom, a permanent and slightly meandering stream, perhaps a small terrace and a flood-plain. How have these changes been produced? is now his problem. He learns that the gully acquired a permanent stream when its bed was eroded deeply enough to secure a constant supply of ground-water, *i. e.*, below the ground-water level. He learns that the current cuts continually on the outside of the bend and makes the stream more crooked, and in doing so it (1) has undercut the sides of the ravine making it wider and flat bottomed, (2) has produced the *flood-plain*, (3) coupled with erosion on the stream's bed, has sunk the meander belt (belt in which the bends occur) below the level of its surroundings and formed *terraces*. If the stream has swung to one side of the ravine he finds that side steep and actively eroding and finds the terraces on the opposite side (Fig. 1). But if the stream is in the middle of the ravine he may find terraces on both sides of it. If the stream is a very crooked one he probably can find places where it has cut across the narrow part of the bend and abandoned the meandering channel forming an *oxbow lake*.

After the above study a visit to the valley of a large river will show it to be like a ravine only on a larger scale, *i. e.*, a gully represents infancy, a ravine middle age, and a valley old age. These terms, of course, are only relative in value and apply to the stage of erosion and not to years. Are all valleys grown up gullies? and Do all gullies form valleys? are problems that should not be overlooked at this point. That many gullies on a side hill perish as the result of the more rapid growth of one can be demonstrated easily in the field, and that many streams flow away from glaciers, snow fields, and from lakes without ever having occupied gullies will be recognized by the student.

Work of Deposition.

Causes of deposition.—During the study of erosion the fact

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FIGURE 1.—Terraces along the side of a small ravine.

of deposition has become apparent to the student. He has noticed deposits at the mouth of the gully, on the inside of the meanders, and at the mouth of the stream where it flowed into quiet water. What causes a stream to drop its load? is evidently the key to an explanation of these deposits and is the problem that he must solve first. He observes that the current goes slower on the inside of the bend than on the outside, that it is checked when it flows into a body of quiet water or when it flows from a gully onto the more gentle gradient at the base of the slope. In other words he has learned that, *a stream drops sediment when its current is checked*, and some of the ways by which the current may be checked. From these facts he can reason out other causes if field examples are not available. For example, such causes as: gradient of the valley becomes less toward the mouth, loss of volume due to sinking into the ground, to evaporation, to withdrawal for irrigation, to the dividing of the stream into many channels; and overload.

Places of deposition and types of deposit.—That there are three chief places of deposit by running water, viz., at the base of slopes, on valley bottoms, and at the mouths of streams, be-

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comes clear to the student as he continues his field work. It remains for him to determine what these deposits are, and their characteristics. On the gentle gradient at the mouth of the gully he finds a fan-shaped deposit extending away from the gully's mouth (1) with a comparatively uniform slope, (2) with the coarsest material at its apex and the finest around its outer margin, and (3) with numerous little stream channels extending from the apex to all parts of the fan. He notes that the fan-shape is due to the shifting of the temporary streams from one side of the deposit to the other. Why do they shift? An application of what he has learned makes it clear that a single rain shower may build up one side so high that the water from the next rain will go down the other side. This deposit is an *alluvial fan.*

At the mouth of the stream, where the current is checked by coming in contact with quiet water, he finds a deposit of fine alluvium. This is the *delta.* Above water it resembles the alluvial fan but a few soundings off its outer edge will show it to have a steep front slope. Usually it is composed of finer sediment than the fan. Miniature deltas may be found frequently in shallow pools formed during a rain shower.

FIGURE 2.—Natural levee along Thorn Creek, near Chicago, Ill.

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In the valley bottom the student finds fine sediment on the *flood-plain* and *terraces* and learns that those features may be the work of both erosion and deposition. He needs little assistance now to explain this situation or the presence of *sand bars* in the channel. But when he approaches the stream and finds that the flood-plain is higher immediately along the bank than back from the river he discovers a new and often a perplexing problem. This feature is a *natural levee* (Fig. 2). Why in flood times, did the stream deposit more along its banks than farther back? The fact that the overflowing current is checked there *first,* by coming in contact with vegetation and the quiet flood waters is easily within his reasoning ability.

Life Relations.

During all field work the relationship of the work of running water to plant and animal life, especially human life, should be kept constantly before the student. It is desirable in the study of each feature to raise the question of its importance, both positive and negative. The agricultural value of flood-plains, deltas, and alluvial fans; the use of streams for power, commerce, boundary lines, irrigation, pleasure, sewage disposal, and for drinking water, is known to most boys and girls, yet it is doubtful if they have ever really correlated them in the field.

A Field Trip to Thornton, Illinois

Phyllis Gordon.

On our way to Thornton we saw the old lake Michigan outlet, and shore line. The outlet is a long, wide flat, bounded on either side by low hills which mark the old shore line.

The topography of the Thornton region is slightly rolling, and is called a ground moraine. The debris which the glacier deposited when it melted back is the origin of the hills. The soil is made of sand, clay, and loose rocks of every kind and size. The region is in youth, while the river is in a slightly later period of development. Running water in this case has not cut out the hills, the glacier deposited its load in hill form.

Erosion by running water is well shown in this region. The strongest current is on the outside of a bend and therefore, there is where the most erosion will occur. At one place the river meandered over a good sized flood plain. On one side the bank rose almost perpendicularly, but on the other there was a small

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natural levee, and after that a broad flood-plain. The steep bank was on the outside of the bend in the stream.

A river carries its sediment according to the amount of surface in comparison to the weight. The heavier load is rolled along the bottom of the river, while the lighter is carried suspended in the water by means of small currents made by boulders or irregularities in the surface of the stream bed.

The amount of load a river carries greatly controls its cutting ability. Sediment is the tool of a river in erosion. The river got most of its load from banks and the stream bed.

The growth of a gully was very plainly illustrated on the Thornton trip. One of the principal ways of a gully growing is by head erosion. The stream soon cuts back and the property at the gully's head will be broken up. We saw a good example of this. A farmer wished to drain his land and so dug a ditch which he connected with the head of a small gully which was on his property. When we saw the place the gully had been cut back so far that a great hole had been made in the farmer's corn field. The addition of the extra water from the draining ditch had hastened the development of the gully very much.

Another way of gully growth is by widening. The stream does this by undercutting its bank, and with the help of ground water, which is very instrumental in making slumps and creeps, the banks fall slowly into the stream and are carried away. As I have said before, the current is stronger on the outside of a bend than on the inside, and therefore, if the river meanders, the work of side cutting will go much faster. An illustration of cutting on the outside of a bend was shown on this trip by seeing a farm house on the edge of a cliff-like bank. The farmer who owned the house said, that a few years ago when he had come to live there, a grove of trees separated the house from the river. Now he expected to see the house, too, go soon.

The third way a stream enlarges a gully is by erosion on the bottom. When the stream carries much heavy sediment which is rolled along the bottom the stream bed is quickly deepened.

When a river has widened its channel enough to meander it has a flood plain which is usually very fertile. When a stream is near enough base level to have large meanders, in times of flood the swift current often cuts off one of the meanders by making a new channel through the narrow divide. The eliminated meanders are filled with water and because of their form are called ox-bow lakes.

Terraces are formed to a large extent by a meandering

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stream. When the stream has cut down to a certain level and changes its course the new level which it makes will form a terrace. Another way in which terraces are made is found where the underlying layers of rock are horizontal. The river can not cut so quickly through the second layer of hard rock as it could through the first layer which was soft. The river in that case may cut down more rapidly than sideways and so form a terrace.

The main place of deposition of the Thornton stream is on the valley bottom and takes the form of islands and sand bars. When a branch, or some other obstacle, is caught, the water in striking it is checked, and drops some of its load. As the stream drops its sediment around the branch, the obstacle grows and more water is checked thus an island may be formed.

When a stream is overloaded, or its velocity is checked it must drop some of the load in the stream bed. This is how sand-bars are made.

Natural levees are formed in flood time. When the stream overflows its banks and still water is standing on either side of the main channel, the swift loaded current strikes the still water, its velocity is checked and it drops its load right on the edge of the main channel. As a stream cuts on the outside of a bend it deposits on the inside and so land is formed on the inside of a bend.

There are many causes of stream deposition, but the main cause of the Thornton river's deposition is loss of velocity.

Vegetation is a great hindrance to erosion. The roots of trees hold the soil, and even grass makes erosion more difficult. At one place, where the river had washed away the soil in widening its valley, only the soil around the roots of the trees remained.

The Way of a Caterpillar

ELLEN ROBERTSON-MILLER.

It is worth while to stop occasionally and take note of how the insects manage to get on in a world filled with enemies.

We soon learn that every species has its special methods of evading or combating animals bent upon its destruction—and the methods used often prove a fascinating study. I have found the behavior of caterpillars especially interesting.

Take for example, the common Mocha-stone, Ich-thy-u-ra in-clu-sa. These lavae live in family groups, and frequently in rather crowded quarters, but they seem never to show irritability, no matter how much crawling over and under each other occurs.

The nests of the Mocha-stone may be seen on poplar and

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other kindred trees throughout the summer, although I have found them most numerous early in September, when the caterpillars are about grown and the cocoon-like nests quite conspicuous.

The Mocha-stone moth deposits her eggs in a mat-shaped group, and when these hatch the little crawlers draw the edges of the leaf on which they chance to be born together and snuggle down within, eating the green tissue of the leaf until lack of food forces them to add a second leaf to the first, or, more frequently, they migrate to a larger leaf. This leaf they line with silk and web together in such a way that it forms an oval room which at first glance appears not unlike the cocoon of a big silk-spinning caterpillar known as Telea polyphemus, but its walls are not so dense and the silk is more like that spun by spiders. The resemblance is intensified by the fact that the Mocha-stones carry the threads from the lining of the leaf around and around its petiole and then they fasten these about the parent twig, much as do some of the polyphemus larvae.

The shape of the leaf when rolled is such that there seems always to be an open space at the upper end of the cocoon. Apparently the caterpillars realize that a bird which had discovered their whereabouts could secure each and every one of them through this opening much more easily than it could if the opening were closed, for we find in the nests of the grown larvae, at least, a piece of densely spun silk stretched across the opening and fastened to its edge, but in such a way that a round hole is left at the side of the petiole, and through this the caterpillars go to and return from their feeding gounds.

The doorway is too small to allow more than a single larva at a time to pass, and it is amusing to see how one will poke out its head as if reconnoitering, then, if the road is clear, it will crawl up the stem to a leaf and begin to eat. Occasionally, however, two individuals meet at the threshold, but when this occurs there seems never to be any caterpillar controversy as to which shall go first. One or the other yields its place instantly and waits his opportunity.

Such a meeting occurred between the larvae shown in the illustration. The returning caterpillar in this instance crawled to the side of the nest and remained there until his fellow had passed out and left the opening free for him to enter.

Now, have these Mocha-stone larvae a vague notion that a squabble over their rights might attract the attention of bird enemies, or are they instinctively the Gastons and Alphonsos of the caterpillar world?

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MOCHA STONE CATERPILLARS AND NEST. (Life size.).

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Hygiene as Nature Study

F. M. Gregg,

V. A Study of Water.

It is not to be expected that pupils in the fourth and fifth grades shall figure in a campaign to improve the water supply of a community, but there is a good deal of valuable information that can be given them in such an impressive way as to make it accrue to their own personal health, and, in time, to the very great advantage of the community.

(*a*) The Nature-Study Approach.

1. *Properties of water.*—(a) The boiling point and vaporization of water can advantageously be studied by putting a pint of water into an empty can, such, for instance, as has had linseed oil or liquid paint in it. A larger can would serve even better. By suitable means bring this water to the boiling point, and with a thermometer (a cream thermometer is convenient) determine the temperature of the vapor and of the boiling water by lowering the thermometer into the can. That the can is now practically filled with water vapor will come out impressively by taking the can from the heating flame, stoppering tightly the mouth, and then pouring cold water over the outside of the can so as to cool the vapor within. Ordinarily, the can will weirdly collapse with startling contortions, due to the removal of pressure from the inside to counteract that of the air without.

(b) The freezing point of water may be determined by taking the temperature of water that has plenty of ice floating in it, or by the employment of simple freezing mixtures in the production of ice, for which see any good text-book on Physics.

(c) The solvent power of water can easily be shown by taking say two glasses of clear water from any ordinary source. Into one put a teaspoonful of salt and into the other a teaspoonful of sugar. Stir till both are as clear as before. If it is felt to be worth while and "straws" enough can be inexpensively secured, such as are used at the soda fountains, the pupils by tasting may verify the fact that the waters are now different from what they were before, though they look the same.

(d) The power of water to absorb gases, such as oxygen, comes out by taking two small bottles of water that has had a chance to take up the oxygen of the air, boiling one for several

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minutes, taking now some bright new shingle nails and putting two or three in each bottle, and then corking up tightly. In the course of a day the nails in the unboiled water will show rust, while the others will show little if any rust. Have you noticed that fish in an ordinary aquarium sometimes keep their mouths steadily near the surface? Why is this and when does it occur, answered in terms of the length of time the fish have been in the water? Have you noticed that sometimes when water "looks good" it may "smell bad?" Explain.

(e) It is worth while to give the pupil a concrete demonstration of the power of water to carry particles in suspension, and especially some idea of the relation of velocity to the size of particle that can be carried. The cut here presented shows the means by which the gross facts can be set forth interestingly and luminously, provided access may be had to a water supply through a faucet and under pressure.

(*B*) is a glass tube four or five feet long and about an inch and a half in diameter, and is held in a vertical position by a suitable device. Inserted in the lower end of the tube (*C*) is a stopper having a hole into which is thrust a short tube such that it can take on a rubber tube (*G*) leading from the faucet (*E*). A handful or two of sand, gravel and fine dirt are thrown down into the tube and a stopper like the one at (*C*) inserted in the top (*A*) and connecting by a rubber tube (*F*) with the basin (*D*). Turning the water on slowly so as to produce a current through (*G*), (*B*) and (*F*), the finer particles of dirt in the tube are now carried up. Now doubling the velocity of the current by turning the faucet so as to have the water rise from (*C*) to (*A*) in half the time it did at first (the amount of turning necessary should have previously been determined), note that the largest particles now carried up are about four times the diameter of the particles carried up at first. Increase the velocity to three times that at first and the largest particles will now be about nine times the diameter of those at first carried up. Stop the flow of water and watch the stratification of the particles as they settle. What sizes drop first? What later? Why?

2. *Kinds of water.*—(a) Prepare some soap solution by dissolving a small piece of soap in a bottle of hot water. Get a sample of water that is called "hard" water and into a small quantity of it put a little of the soap solution. Notice how the mixture curdles and does not form good soap suds.

(b) Take an equal amount of "soft" water, such as clear rain water, and put into it a similar amount of soap solution as

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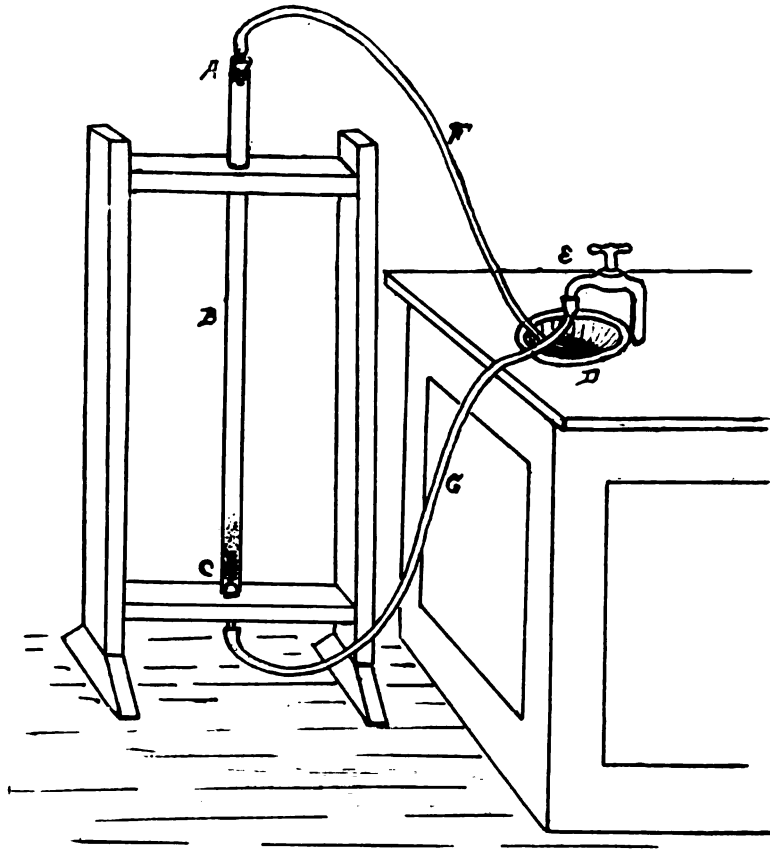

before. Shake and compare the suds now gotten, with the results from the "hard" water. Which of the two kinds of water is best adapted to washing and cleaning where soap must be used?

3. *Common sources of water and their impurities.*—(a) Secure a sample of water from a well or spring. Pass some of this water through clean filter paper into a bottle. Is there any solid stuff left on the filter paper? Are there any "wigglers" in it? Any germs? You could find out by "planting" some of the stuff on a germ culture medium. Let the water that passed through the filter onto the bottle either dry away or be boiled away, and see if any stuff is left on the glass surface. Where was it before the water dried up?

(b) Similarly treat water from a cistern. Compare the

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quantity of stuff in solution and in suspension with that in the well water.

(c) So also a sample of tap water, if it is at hand.

4. *Purification of water.*—If water is to be purified at the point where it is delivered for use, one or more of the following methods are employed:

(a) Filtering may be impressively illustrated by taking several ordinary flower pots that will hold a quart or more, each, filling them each with a different grade of material, from very fine sand to course gravel, and then pouring a pint or less of very muddy water in each and collect the water as it comes through the hole in the bottom of each vessel. What makes the difference in the clearness of the waters that come through? Can you make use of what you learned in experiment 1(e) to explain it? Examine a commercial filter if one is available.

(b) Even though the water that comes through the fine sand is clear, we are not yet sure that it may not have live germs in it. What can we do to kill the germs and still preserve the water? Yes, if we boil the water long enough we can kill all the germs that may be there.

(c) But even now the water may still have minerals in solution, and to get perfectly pure water we must distill it. Nine and ten year old boys will be glad to make a distilling apparatus, if the teacher will encourage them and show them pictures of how distilling apparatus may be made. The books on physics will describe the process. But better than the practice of purifying the water at the point of delivery is that of purifying it at its source. Here the pupil may be sent to the books and to various wells and cisterns, to see how they can best be arranged so as to guarantee reasonably pure water. If a city waterworks is accessible, of course an excursion to such a place would next be in order. Our experiments up to this point should help make the processes clearer.

(*b*) HYGIENIC CONSIDERATIONS AND CONCLUSIONS.

Do you think it makes much difference what kind of water one drinks? Why should we be particular about this matter? What is the objection to taking a drink with a cup that some one else has just taken a drink with? What is the advantage of the drinking fountain? Are there any disadvantages? What should be done with a boy or girl who persistently "fingers" the cup of a drinking fountain? About how much water do you drink in a day? Suppose we all keep track of it for a week and then

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divide the number of cupfuls by seven. May be it will turn out that some of us are not drinking our share of water. If so, we shall not be at our very best until we do. All people are not agreed whether we shall drink most of our water at meal times or between meals, though all say that we should not drink at meal time merely to help swallow our food quickly. Can you think of reasons why it might be better to drink most of our water at meal times if we do it properly?

Editorial

This NATURE-STUDY REVIEW is "devoted primarily to all *scientific* studies of Nature in elementary schools"; so it is and always has been declared upon the title page. The essence of scientific study is this—to observe for one's self, to achieve, upon the basis of the facts so discovered, conclusions that are secure. The scientific spirit implies a reverence for and loyalty to such opinions that makes for a fine devotion. And truly we need to cultivate such a scientific attitude of mind in a democracy. Our opinions are too prone to be resultants of caprice and prejudice rather than rational conclusions, based on an adequate mass of data. The scientific spirit needs be cultivated in the child in the grades, else the average citizen is likely never to acquire it.

Nature study is method rather than content. The chief aim in instruction is not to impart a mass of information but to give to the pupil a mental attitude; habituate him to think clearly upon a wide range of personally acquired facts, to marshal them wisely, to relate them cautiously, to draw conclusions discreetly. Until he can do this, let him reserve judgment and refrain from an opinion. When this has been done, inspire boldness to make his assertions, tenacity in his adherence to them and a willingness to revise his opinions upon the presentation of new facts. We stultify our pupils, crush their expansive minds with the weight of ready-made, second-hand opinions we force upon them. Then we bemoan their lack of virility, acumen and stamina. Nature study is a protest against formalism, bookishness and education by accretion. It stands for direct contact with materials, the absorption of essential data and mental growth by the solution of real problems.

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Book Reviews

Health and Medical Inspection of School Children, Walter S. Cornell, M. D. Pp. xiv+614. F. A. Davis Co., Philadelphia. $3.00.

This is a very timely book. School authorities are everywhere interested in the conservation of the child's health. The great mass of data presented makes the need of inspection apparent. The ways and means of accomplishment are clearly presented. The method adopted to eradicate the evils detected are forcibly indicated and enough of the results already achieved is given to make the book a valuable force in the crusade for healthful schools and healthy children. Dr. Cornell is Director of Medical Inspection of Public Schools in Philadelphia and lecturer on child hygiene in the University of Pennsylvania. He therefore writes with a wealth of information at his disposal. At points one needs a medical dictionary handy to get at his meaning but usually he is quite clear to the lay reader. The book is marred by the imperfections of some of the numerous half tones. Several are too indistinct to make apparent the point they are supposed to illustrate.

Soil Conditions and Plant Growth, Edward J. Russell. Pp. 168. 59 Tables. Longmans, Green and Co. $1.50.

It is always of interest to teachers to find in a single compact volume a comprehensive survey of a single subject. In the book in question the author has endeavored to "give a concise account of our present knowledge of the soil as a medium of plant life." The subject is a particularly complex one and many important facts await satisfactory explanation, but Dr. Russell has succeeded in giving a coherent and comprehensive account of the matter. An immense amount of information is compressed within the small volume, and much of it is tabulated in very convenient form for reference. Discussions of theory are clear and concise. Since the author is an Englishman it is natural that British data are largely used particularly those from Rothampstead, but this does not make the book less valuable to American readers.

That the author's conclusions will pass unquestioned is not to be expected. There are many unsettled questions in soil study and the chapters which touch these questions are sure to be criticized by one school or the other. In particular is the theory of fertilizers here presented out of harmony with the views of a large number of modern investigators.—W. L. Eikenberry.

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Pure Foods, John C. Olsen. 210 pages. Ginn & Co. $0.60.

This is a very excellent simple presentation of the subject. Dr. Olsen is Professor of Analytical Chemistry at the Brooklyn Polytechnic Institute. He writes clearly, concisely yet interestingly. Here are some of the chapter headings: What is Pure Food; Standard Rations and the Cost of Food; Milk; Butter and Its Substitutes; Meats; Candies; Fruits, Jams and Jellies; Bread and Cereals; Spices and Condimental Foods. He adopts a standard ration of 100 grams of protein, 100 of fat and 420 of carbohydrates—a generous ration. In the preface are these significant sentences which suggest the purpose of the book: "The steel for our bridges and buildings is bought and sold on the chemist's certificate of its composition to the thousandths of per cent. The coal for our engines must be tested and analyzed but the far more precious human organism is loaded with a heterogeneous mixture of fuel of unknown composition. We should not be surprised at low efficiency, inability to work, sickness, even premature death of an organism which is given so little intelligent care.

Hygiene for the Worker, Wm. H. Tolman and Adelaide W. Guthrie. 231 pages. American Book Co. $0.50.

It is important to the laborer, to his employer and to society that he keep well. This little volume tries to emphasize those rules of hygiene and sanitation that apply particularly to the worker. Aside from the chapters one would ordinarily expect in any hygiene there are some suited especially to a work of this type: Applying for a Position; Preparing for the Day's Work; The Noon Hour; Hygiene of the Workroom; Occupational Dangers; First Aid to the Injured. The book is well written, lucid, emphatic and may well be added to every school library to be read in whole or in part by every boy and girl. The chapter on the "Choice of an Occupation" is especially suggestive to those who are anticipating life's toil.

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THE
NATURE-STUDY REVIEW

DEVOTED PRIMARILY TO ALL SCIENTIFIC STUDIES OF NATURE IN ELEMENTARY SCHOOLS

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VOL. 9 APRIL, 1913 NO. 4

A Grand Rapids School Garden

FRANCES VAN BUREN.

HOW WE STARTED A GARDEN.

When we began our school garden at the Oakdale School of Grand Rapids, Michigan, we encountered many difficulties. The school house, just completed, was on the outskirts of the city, the land having been a common that had never been improved. A great deal of sand had been thrown out by the workmen in the only desirable place for a garden. So, starting one under these conditions was rather hard, as two enemies, sod and sand, had to be conquered before anything would grow. A small garden containing bulbs, perennial plants and a few shrubs had been started near our old building two blocks away. These formed the nucleus of our present garden.

Our greatest problem during the first summer was how to protect the garden from roving animals, chickens, etc., for there was no fence around the school property. Our entire allotment per room for gardening was spent that summer in building a one-board fence. Several rows of corn that served as a hedge and kept off the wind, were planted just inside the fence. In spite of all difficulties we were rewarded that first summer by a great mass of bloom although we had few varieties of flowers or vegetables.

The next spring we were able to persuade the Business Manager of our schools that we were actually making good and could have still better results if a strong wire fence were built around the place. This was done and the space was enlarged until we had a plot of ground ninety feet square.

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DIVISION OF GARDEN SPACE.

It seemed advisable to have quite a large general garden, so half the space was used for that purpose. Each room in the building, including the kindergarten, was assigned a portion of this space about fifteen by twenty feet. Plans for their gardens were made by the children as a part of their regular work, the work including problems in arithmetic, drawing, language and spelling. After deciding what they would plant they were taken out-of-doors where they spaded, laid out and planted their gardens working as a room. The large boys with the janitor's help also spaded the rest of the ground, measured and laid out the beds with paths between. At first the beds were elevated, but we found it much harder to keep them well watered. Last summer we had them nearly level with the paths which proved more satisfactory. About a fourth of the space was given to children for individual gardening. The second summer we had sixty varieties of flowers and sixteen kinds of vegetables.

TRANSPLANTING.

We have had good success planting the seeds out-of-doors and then transplanting later. This last spring as the season was so late much of this had to be done after school closed. Many times I went out to school where I was always joined by ten or fifteen children and sometimes some of the teachers also assisted in the work. They were greatly interested and helped to stimulate the interest of the children.

To avoid transplanting after school closes we have had a small cold frame about 4 by 12 feet built at the rear of the garden, where we can raise seedlings that will be ready to transplant as soon as it is warm enough in the spring. These can be planted about the 10th of March. If this proves feasible we shall build more of them next year.

VARIETIES OF FLOWERS.

Last summer we raised a great many hardy perennial plants from seeds, such as sweet Williams, oriental poppies, lychnis, anchusa, etc. These made fine young plants that were carefully protected last fall. Many of them that we raised from a ten cent package of seeds would bring fifteen or twenty cents apiece at the florist's. We shall change the plan of our general garden greatly this spring, as we have so many of these perennial plants to use. When the men are hauling away dead leaves in the fall if you can secure a load or two, they make an ideal covering for your flower beds. We did this.

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At the back of the garden we have a long row of hollyhocks, golden glow and fleur-de-lis, and as each blooms in turn, it forms a splendid mass of color extending across the garden's entire width. At the south side we planted our shrubs that came from the grounds of the old building. A number of these were the snowberry bushes and they were particularly beautiful last fall. In front of the shrubs are tulips, crocuses and narcissus. Vines were planted to cover the wire fence and rows of sunflowers were placed outside.

Our dahlias, gladioli and cannas were all carefully lifted by the janitor and children and stored away in the basement ready for spring.

BULBS.

Two years ago we began raising bulbs in the winter. These were purchased by the Civic Health and Beauty Committee of one of our literary clubs and came from Holland. They were fine large bulbs and were sold to the children for a small sum. We had a florist come to school and explain the method of raising them. We potted the crocuses, hyacinths and tulips in pots solicited from my friends, many of whom were glad to get rid of them. A junk dealer in the neighborhood gave me thirty or forty pots and he was remembered when the bulbs were in bloom. The children brought very few of them. When the supply was exhausted we used chalk boxes, cheese boxes, anything we could get. A trench was dug in the garden, lined with boards, filled with several inches of dirt and left until the first of February. When that time came the pots were brought into the house and placed in a cool dark room for two weeks and occasionally watered. Many of the bulbs had grown an inch or more. The tulips we learned, should be kept in a cool place until the leaves were well developed; otherwise the buds blasted. They were gradually brought into a warmer, lighter place and watered more frequently in order to have them in bloom at a desired time. Keeping them longer in a cool place delays the blossoming. We found they thrived better if kept in a sand table in several inches of sand.

IN BLOOM, FEB. 20, 1912.

WINTER EXHIBITS.

For two years we have had a bulb exhibit in the Assembly

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Hall of our school, once in March and once in April. Last April we had hundreds of blooms, pots and boxes of trumpet daffodils, poets' narcissus, crocuses, tulips and hyacinths. Each room raised one particular bulb and as theirs were planted in boxes it was a gorgeous sight to see thirty or forty orange tulips or twenty or thirty hyacinths blooming in one box.

Our school secured a prize of five dollars, offered by the club selling the bulbs, to the school having flowers in bloom the greatest number of days in the school year. Beginning with the 10th of December they bloomed continuously for 142 days. This year our first pot of paper white narcissus was in bloom December 6th.

It occurred to me last spring that we might be able to sell some of our flowers so they were offered for sale just to our patrons, a single hyacinth in a pot selling for 10 cents, a pot of daffodils, 25 cents, etc., the price being less than half charged by the florists. Ours were in bloom at Easter time, when flowers are in great demand. We sold ten dollars worth of flowers besides having a large exhibit and having them in bloom in the house all winter. We used the money to purchase bulbs for this winter. As there seemed to be a greater demand for hyacinths we have potted two or three hundred that we hope to sell at Easter time.

INDIVIDUAL GARDENING.

Last spring we determined to pay more attention to individual gardening. So the Business Manager was persuaded to fence a piece of land half as large as the first adjoining it on the north. This we had plowed, as it was nearly all sod, and divided into twenty plots of ground, about 7 by 18 feet. The garden plots were given to the children only upon request and a note was sent to each parent making them, together with the child, responsible for their care. They were given permission to do as they pleased with what they raised. We had almost everything in the gardens from cabbage to sweet potatoes, and zinnias to forget-me-nots. They planted just what they wished. As long as the supply lasted they were furnished with government seeds, but many purchased their own. As far as possible we tried to assign the plots to needy children.

To stimulate interest I offered a prize of a dollar to the child having the best garden in the fall. This amount was divided by the judges between the two children having the best vegetable and flower garden. This same sum has been offered for their next summer's gardens.

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We tried to teach them to have a succession of things growing and when one was exhausted to plant another. One boy sold a bushel of beans and one girl a bushel of lettuce after supplying their mothers and neighbors all summer. This spring we want to give a garden plot to each child wishing one. About 100 of our children each want one and as we have as large a space in use now as our school property will permit, I have secured the use of a vacant lot across the road from the schoolhouse. It has already been plowed by a neighbor who donated his services. In the spring it will be fenced in and laid out by the children as before, and we hope to obtain better results after our experience last summer.

PRIZES.

The fall after we were established in our new building, we received the first prize for the best school garden in Grand Rapids at the West Michigan fair. One of the officers of the fair noticing the exhibit urged me to enter the flowers in competition with other amateur florists in the horticultural building and referred me to the man in charge of this exhibit. I went to him, found him greatly interested and was urged by him to enter the flowers, late as it was. Although I had never seen him before, he loaned me the entry money and the day given to teachers to visit the fair was spent in preparing for this competition. We secured five dollars at the horticultural building in addition to a three dollar prize for the best school garden. We also had a prize of three dollars given by one of the literary clubs for raising the best bouquet of bachelor's buttons. This gave us a better financial basis upon which to work and enabled us to purchase a better collection of seeds and plants for the following spring.

IN BLOOM, MARCH, 1912.

With our prize money we purchased half a dozen ramblers, peonies, phlox, shasta daisies, pyrethrum, etc. Some of our patrons were market gardeners and they sent us tomato, cabbage and pepper plants which thrived splendidly. One of the members of the Board of Education offered a prize of fifteen dollars to the school having the best general garden, which prize we were fortunate enough to secure last fall. This, in addition to eleven dollars won at the fair and the five dollar prize for

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bulbs, netted us thirty-one dollars that we shall use this coming spring in making the garden still more attractive.

Some of our money we shall use in purchasing garden tools which children rarely bring from home.

DISTRIBUTION OF FLOWERS AND VEGETABLES.

We have a thriving Mothers' Club in connection with the school and a committee was appointed from the club to distribute the flowers around the neighborhood or take them to the hospitals during the vacation. Many of them were given to the churches for decoration. We have given away many plants, bulbs and seeds to the children and neighbors.

Now that our garden is so large there are many seeds that can be saved in the fall. The children make seed boxes or envelopes and go out with the teachers and gather them.

When giving a drawing lesson it is of inestimable value to the teacher to be able to have a garden at hand where specimens enough for an entire class can be secured instead of having to depend upon the possible chance of the children bringing them. Each fall we have sent a load of vegetables to the Children's Home of our city and sometimes the parents supplement this offering with vegetables from their own gardens. We have never failed to find some kind neighbor who will loan his horse and wagon to us for such occasions.

The garden has proved to be a veritable beauty spot for the entire neighborhood and seldom is anything molested, although it is rarely locked. On Sunday afternoons any number of the people may be seen strolling around but never offering to touch a flower. They know that it belongs to the neighborhood and respect it accordingly.

CARE IN SUMMER.

One of the greatest problems confronting us is the care of the garden in summer. No one is regularly employed to have charge of it and unless you have a summer school or have the janitors there it is a problem, as children certainly need supervision and encouragement in caring for their gardens. Our Mothers' Club helps to some degree in this respect.

A shed for the garden tools should be built that is accessible to the children, and some person understanding children and gardening should be with them part of each day. Much better results would be obtained if this were possible.

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The Bluebird's Housekeeping

S. Louise Patteson.

A Bluebird pair, on returning from their southern home one February, found a new bungalow under their last year's nest tree.

Near by there was also a feeding board with a piece of suet on it, over which was a scattering of raw rolled oats. All of which looked very friendly; but Bluebirds never did care for alms, and not until the Song-Sparrow arrived did the lunch counter get a patron.

One April morning the Bluebirds found a neat birdhouse and then there was a flurry of excitement.

The house had two compartments, one in front, the other at the rear. The birds favored the front one, and after spending a few moments inside, hopped out onto the porch and talked it over.

"Just right for our nesting," said the darker of the two, whom the lady in the bungalow called Girlie.

"Let's move in before someone else does," assented the other. With this Girlie flew to the ground and gathered the first billful of grasses for the nesting, while Boy Blue, as the lady named him, stood guard.

For the lady had a cat that sometimes crouched on a low fence rail, or hid in the weeds, and watched the birds as they hunted for food. Once she almost caught Boy Blue, and he meant to see to it that she shouldn't get his Girlie.

One day, after the nest building had been going on for a while, the cat did climb up the tree on which the house stood, smelled around, reached inside, and perhaps would have spoiled Girlie's work if the lady hadn't come with a long handled rake and poked the intruder down. After that a sheet of tin was nailed around the tree, and the cat couldn't climb it any more.

Boy Blue had a long, wordy, tender song:

"Deary dear deary dear, oh deary dear deary!" with all sorts of variations. But he sang it so softly and low, evidently it was meant for Girlie's ears, and nobody's else.

Sometimes she answered him with a curt but sweet "dee-ar," which always made him fly to her; and at his approach she twittered softly, and joyfully fluttered her wings. They certainly loved each other, and he was quite as proud of her as she of him, although her back was only a slatey blue, and her breast a dull

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brick red, while he had a bright salmon front, and a back the color of the sky.

Boy Blue's job as guard and entertainer kept him very busy, and still he wanted to do more. Several times he brought some material for the nesting; but it never suited Girlie, and he always had to drop it to the ground instead of being allowed to toss it into the house. But presently another job opened up for him. The English Sparrows tried to nest in the rear and had to be routed. No doubt it was due to Boy Blue's watchfulness that that other part was never occupied, and the lady took the hint to make no more double birdhouses.

In a fence corner Girlie found the matted feathers of a chicken just as they had been dumped from the dish-pan. As sun and wind dried the topmost of these feathers she soon had enough to line her nest soft and downy. This saved her from doing what is said of birds, namely, that they will pull out some of their own feathers if they can find no others to finish the nest.

Many spring flowers were in bloom by the time Girlie had her house furnished to suit her. Then she loved it so well that for a fortnight she stayed in it almost constantly, and Boy Blue fed her as one would a helpless baby. But sometimes when he had an extra nice worm he wanted to enjoy it himself a while: he would alight on the edge of the platform and wait until Girlie came to the entrance and chirped something to him. Perhaps she said "Hurry, dear, I'm starving," or something like that. Then if he didn't go to her she came out, and with a saucy air snatched his catch from him.

After a while both parents were carrying food to the house, and in another week sounds like z-z-z were heard from within —the babies begging for food. From the bean poles in the garden, from posts in the vineyard, or from fence pickets the parents would pounce on anything that moved on the ground, or upon things that flew about. If a field was being plowed near by, they were there hunting in the furrows. Any big catch like a beetle or a grub they took to a fence post and beat it till it was soft and juicy.

One June morning two bright, wondering eyes peered out of the bird house. The next second a tiny birdling stood on the little porch, and after resting a moment flew into an adjoining tree. When the mother returned he called to her "terwee," as much as to say, "Here I am." Mother answered "dee-ar," and the little fellow fluttered with joy. Perhaps he had expected a scolding for being so precocious.

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BOTH PARENTS WERE CARRYING FOOD TO THE HOUSE.

Evidently those inside had heard and understood, for presently another appeared at the opening, and without as much as stepping on the porch, flew straight to the fence shrubbery where the mother was trying to attract the first one.

By this time father had arrived, and his notes of surprise at what had happened brought two more out of the house, one of whom flew on the bungalow roof. The other, trying to follow him, was less sure of wing and fluttered to the ground, where he was picked up and taken to his brothers in the fence shrubbery. Father then went to the one on the bungalow roof and coaxed him up into the maple, while mother stayed with the three, and instantly the calling ceased. The parents had their young where they considered them safe, and didn't think it wise to advertise the places.

As for the house, it was deserted, and the Bluebirds' beautiful housekeeping was at an end.

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The Small Crustaceans

SECOND PAPER.

W. C. ALLEE.

SMALL ENTOMOSTRACANS.

The other crustaceans to be considered are those usually called entomostracans. This group contains the smaller, less highly developed crustaceans. To be exact, the fairy shrimp would have to be included in this class, but on account of the obvious difference in size it is better to consider them separately. These entomostracans make up the majority of the animal plankton of our lakes and ponds. Plankton, it may be explained, is the term which includes all those plants and animals that live in the water independent of the bottom, that is the floating or swimming organisms that do not come to rest on the bottom. Since these small crustaceans are easily compared as to habits and habitats, they will be considered mainly as a single group.

In the first place all are very small; some are microscopic, while the largest are not over one-fourth of an inch long. The three groups may be distinguished as follows:

I. Segments showing plainly on the surface.
Copepods (Fig. 6, 7, 8).

II. Segments not showing on the surface.
1. The body completely enclosed in a bivalve chitonous "shell."
Ostracods (Fig. 9 and 10).
2. Body not completely enclosed in such a shell.
Cladocera (Fig. 11, 12, 13).

The copepods are more or less cylindrical crustaceans with a plainly segmented body and usually with long well-developed antennae, and poorly developed feet. The antennae serve as organs of locomotion and the animal swims by a series of rapid darting movements. Copepods have a single eye which is placed near the center of the head. There are three main groups which can be easily recognized by the differing lengths of antennae:

I. Antennae very long, 23-25 jointed.
Family Calanidae, Representative genus, Diaptomus (Fig. 61).

II. Antennae shorter, not reaching to the abdomen, 8-18 segments.
Family Cyclopidae, Representative genus, Cyclops (Fig. 7).

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III. Antennae short, not more than ten segments.

Family Harpacticidae, Representative genus, Canthocampus (Fig. 8).

These distinctions can be made out with the naked eye and are easily apparent when a hand lens is used. As is shown in

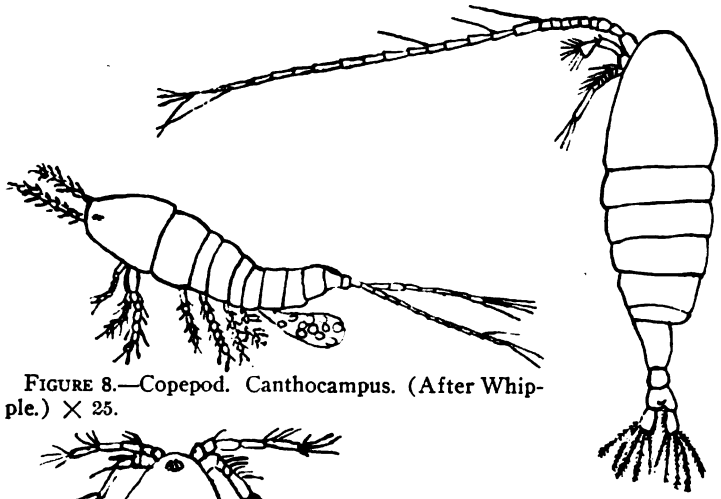

FIGURE 8.—Copepod. Canthocampus. (After Whipple.) × 25.

FIGURE 6.—Copepod. Diaptamus. (After Herrick.)

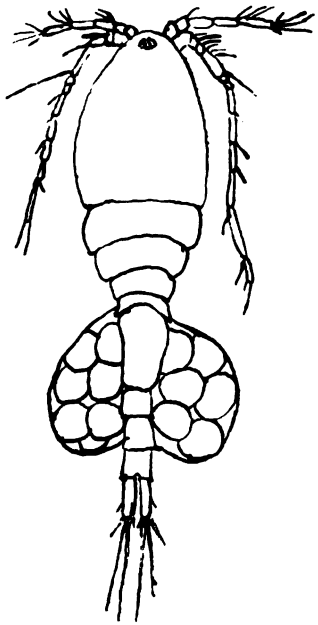

FIGURE 7.—Copepod. Cyclops. (After Herrick.)

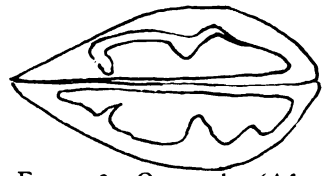

FIGURE 9.—Ostracod. (After Turner.)

FIGURE 10.—Ostracod. (After Turner.) Side view.

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Fig. 7 and 8, the females of this group carry their eggs in ovisacs. In the Cyclopidae family this sac is double, while in the other two groups it is usually single.

The ostracods (Fig. 9 and 10) are easily mistaken for small bivalve molluses in as much as the body is entirely covered by a bivalve shell, closed by powerful muscles. However, the shell is not made of lime but of chiton, and a close examination shows that jointed appendages extend from the body, some of which may be used for swimming or crawling. Here as in the copepods the major swimming organs are the antennae, which are provided with a number of long hairs, forming a dense brush, which acts as a paddle. In size the ostracods vary from about a fourth of an inch in diameter to mere specks in the water, scarcely apparent with the naked eye. Almost all of the ostracods known in North America belong to one family, the Cyprididae. The genera are hard to distinguish even with a microscope so that it is sufficient merely to be able to recognize them as ostracods.

The cladocera (Fig. 11, 12, 13) have a shell which consists of two thin plates that usually do not cover the entire body and sometimes are reduced to small plates near the posterior side and may be embedded under the external covering. They have several pairs of leaf-like feet and, as in copepods, there is a single median eye. The antennae also serve this group as swimming organs. The cladocerans ordinarily collected may be as large as one-eighth inch in diameter though they are usually much smaller. There are several kinds commonly taken, but since these are not as easily distinguished as is the case with the copepods, no description of them will be attempted. Some of the different types may be seen in Fig. 11, 12, and 13.

These smallest crustaceans, like all the others considered here, are to be found as soon as the ice begins to thaw in the spring and continue abundant throughout the summer season. They may be found in Lake Michigan, in any park lagoon, or in any pond that lasts a month or more. The ostracods are more often found on the bottom and are more common proportionately in temporary ponds. Cladocera reach their best development in smaller permanent ponds, while copepods are dominant forms in the larger bodies of water and in temporary ponds.

The number of these small animals that may be present in the water is rather surprising. Thus from representative counts taken from a standard collection from Lake Michigan it has been estimated that over 5,250 copepods alone are present in 100 liters (approximately 28 gallons) of lake water. It is estimated that

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over two quarts of these three groups of small crustaceans are contained each day in the drinking water of the people of Chicago.

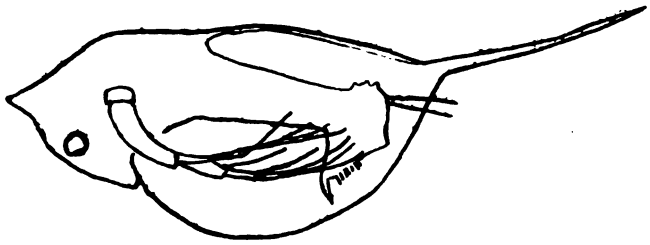

FIGURE 11.—Cladoceran. Daphnia. (After Smith.) × 40.

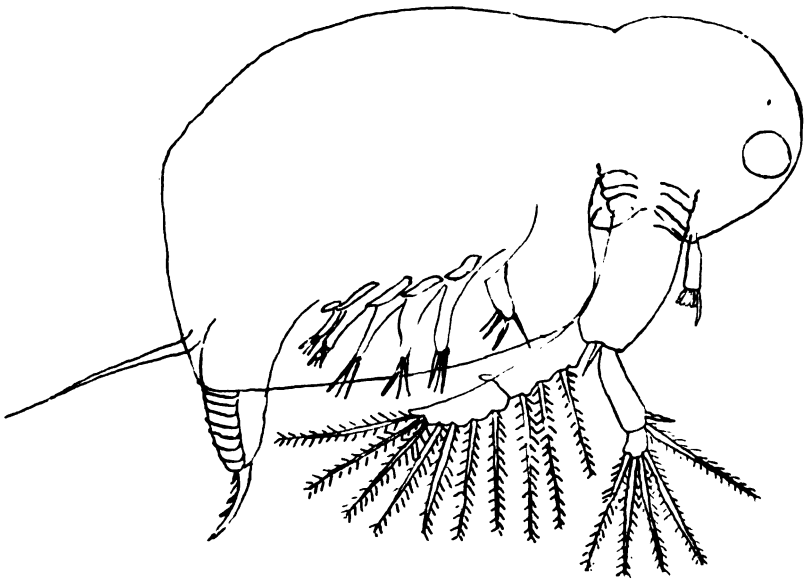

FIGURE 12.—Cladoceran. Seda. (After Herrick.)

These entomostracans may best be collected with a tow net made of miller's bolting cloth which may be drawn through the water or, still better, may be used as a strainer through which water from different parts of the pond may be poured. The net is easily emptied into a Mason jar by filling this two-thirds full of water and turning the apex of the net wrong side out into the jar. In the laboratory it is often advisable to concentrate before

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studying the material. This may be done as follows: Fasten a thistle tube to the apex of a small miller's bolting cloth net, cut off the thistle tube close to the bowl and place a rubber tube over the free end. Close this with a pinch cock. Pour the water containing the entomostracans into this net and carefully wash all down into the bowl of the thistle tube. In this way a great many animals may be secured in a small amount of water. These animals may be collected from any Chicago city water tap by allowing the water to run over night into one of these miller's bolting cloth nets.

Cladocera, copepods, and ostracods all exhibit a daily vertical migration such as has been noted for most of the other groups. As before, light is probably the major cause of this migration. However, it has been shown that for some at least of the copepods this reaction has a different explanation. The females were found to be positive to gravity in the light and negative in darkness and the males simply follow the females but have no other reaction that would cause them to give this migration if isolated. All three of these groups are positive to light of a medium intensity and will collect just at the edge of a shadow. Although they are normally positive to light they are easily reversed in their reaction to it. Thus when daphnia are placed in a dish lighted from one side at first they will all swim to the lighted side, but after being exposed a time some become negative to light and sooner or later all become negative. Thus it is possible to remove all the daphnia from such a dish by picking out the negative ones with a pipette. Shaking some ostracods or even picking them up in a pipette and dropping them out has been shown to reverse their reaction to light.

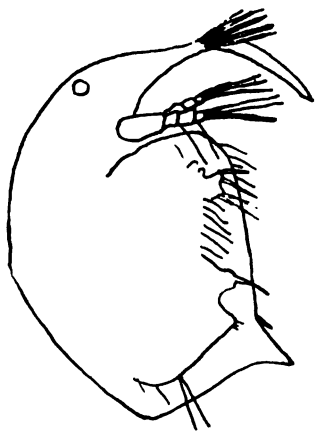

FIG. 13.—Cladoceran. Bosmina. (After Herrick.)

ECONOMIC IMPORTANCE.

These crustaceans are of importance economically. All are food for fishes and in fact they make up the major part of the food of most of our important food fishes. Although all are eaten by fish, yet the distinction of being the real basis of fish food supply is held by the small entomostracans. Not only are these eaten directly by the fishes, but they are the basis of almost every

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line of fish food that may be traced to its beginning. Thus fish eat crayfish, crayfish eat isopods and amphipods, which in turn eat entomostraca. The entomostraca live on smaller organisms, as, for example, the protozoa, and are reported to be able to absorb, through their external covering, food substances dissolved in the water. One other example of the importance of entomostraca as animal food is that they are almost the sole food of the fresh water clam. In fact they are the basis of the food supply of all the animals living in our fresh waters, and in addition are important as water scavengers. Although many other representatives of each group are parasitic, yet, so far as I know, none of these fresh water forms are harmful to man.

SUMMARY OF CHARACTERISTICS.

1. Isopods have a plainly segmented body. The thorax bears seven pairs of similar legs. They are strongly flattened dorso-ventrally. They move by crawling and seldom if ever swim. The adult size is from two-fifths to two-thirds of an inch in length.

2. Amphipods also have a plainly segmented body, the legs are less prominent than in the isopods and they are flattened laterally rather than dorso-ventrally. They move mainly by swimming and often swim on their side. They may reach an inch in length but are more often taken about a quarter of an inch long.

3. Palaemonetes, the common shrimp, closely resembles a small crayfish except that it is a semi-transparent light green color and that it lacks the large pinchers of the crayfish. The adult is from one to one and a half inches long.

4. Eubranchipus, or the fairy shrimp, is about the same size as the common shrimp, but it has no carapace, the thorax is plainly segmented, the appendages are leaf-like, and the animal swims on its back.

5. Copepods are very small, about one-sixteenth of an inch long. They have cylindrical bodies that are plainly segmented, and carry their eggs in sacs that hang from the under side of the animal near the posterior end.

6. Ostracods vary in size from microscopic animals up to those a quarter of an inch long. The body is entirely enclosed in a chitonous bivalve shell which may be closed as in the fresh water clam.

7. Cladocerans are usually less than one-eighth of an inch in diameter. The body is not completely enclosed in a shell and the shell may be reduced to a small plate completely covered by the body wall.

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Nature Study-Agriculture in Rural Schools

BESSIE B. KANOUSE.

If you are a rural school-teacher and you have never tried to arouse the interest of the children in the wonderful, mystifying beauties of nature that are unfolding day by day, begin tomorrow —*just begin*. Until you have tried it, you can not know, and I can not tell you just how much pleasure it will give, nor the inspiration and good-feeling it will lend to the ordinary routine of a school day.

You may think the children already know by instinct about these lovely country wayside things, and the ordinary farm crops, because they live among them and have the chance of seeing them every day. Surely they have the chance, but do they really see? One first day of a fall term, I asked if anyone had seen anything on the way to school that morning that he had never noticed before. Not one new thing had been seen. A short time after we began collecting our nature material of which I am to tell you directly, one of the girls exclaimed, "Why I never dreamed that so many beautiful things grew on our roadsides and in our fields!" So you see it may be possible that there are many, many marvelous things growing within forty rods of your schoolhouse that you never supposed were such near neighbors.

No mind seems so responsive to nature as the child mind. There is a charm about the study that appeals strongly to the heart and soul of a child, when he knows it is his to find and his to enjoy. I quote here from Mrs. Wm. Starr Dana, when I say that, "Through the neglect of nature-study, the wits of the country child lose just the sharpening they most need, to say nothing of a stimulus and delight which can ill be spared by one whose mental life is apt to be monotonous."

The work I am describing was accomplished in a very ordinary eight-grade one-room country school. No special time was allotted for the work. The instruction took the form of oral and written language work in all grades, morning exercises, or informal talks about the material when it was brought. While it is not nearly all that might be accomplished along this line, it seemed to fit the time, the place and the pupils with whom I had to deal.

Early in the spring before the leaf buds had opened, I asked the children to bring branches of as many kinds of trees and shrubs as they could find. We labeled them and put them in

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a large jar of water. Each one contributed a share until we had a fine display. The jar was left in the school room for weeks. Each day brought a change, but the children were constantly on the alert and were always the first to discover the change. From this source we had a splendid chance to study the kind of bark, the kind of branching, the bud protection, the use of the tree from which it was taken and later, to watch the buds unfold and grow into leaves. We noted, too, the flowering of the different trees, how some blossomed before the leaves opened and others not until later. The fifth grade made excellent booklets on trees, and the whole school had lessons in free hand outline drawing from the work on trees.

About the same time that we collected our branches the primary class had a few language lessons in spring work on the farm, leading to crops their fathers raised. So each one was asked to bring seeds from home, and our sand table was transformed into a miniature farm. The sand was divided into lots, one being reserved for the cardboard farm house and barn. The children planted their own seeds in the miniature fields. We had on our farm, corn, popcorn, wheat, oats, barley, peas, beans and clover. It was of great interest and value to the whole school. It is so much easier for the number class to think how many pecks there are in a bushel of corn if a thrifty little plot of their own corn is growing near by. Every few days, we took up some of each kind of plant to find which were making the most rapid root growth, what kind of roots they were, what became of the seeds, just where the root and stalk left the seed and—well, many more things that will occur to you when you try it for yourself.

The previous fall the pupils furnished a cent apiece, and with the money we purchased some bulbs. These added much to the happy spring and truly tulips never looked so lovely to the children as the ones that blossomed then.

A trip to a near-by brook gave us a plentiful supply of minnows, crabs and snails. One of the boys brought a clam. We put the snail on our farm and the children watched it crawl through the oat field and eat a few petals that had fallen from a branch of cherry blossoms. Some cocoons and later some luna and cecropia moths were brought. They gave an excellent chance to teach the story of the moth, butterfly, silk worm, and also to teach the destructive work of the gypsy and coddling moths.

As soon as the wild flowers appeared, we began our compositions in fifth grade language. We secured a good specimen,

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root and blossom, and from outlines the pupils wrote some fine papers. Some of the plants studied successfully were the violet, dandelion, jack-in-the-pulpit, buttercup and wild-strawberry. These furnish a nice variety. I give here the outline we used for the dandelion:

DANDELION.

I. Where and when found? (a) Soil.

II. Root (Fleshy, long, many feeders. Why this kind?)

III. Plant (Stemless). (a) Leaves—(1) number, (2) arrangement (in circle to keep space from year to year, and allow much sunshine), (3) shape (notched to crowd grass away); (b) Blossom (closed on rainy days)—(1) stem, (2) color of flower, (3) perfume, (4) number on each plant (as many as 200); (c) Seed—(1) appearance of seed ball, (2) seed carriers.

IV. Use of plant. (a) Greens and salad (food), (b) medicine, (c) no use to animals; great pest, hard to kill.

The readers furnish many poems on our common wild flowers which we saved and studied when we could have the real flowers at hand. One opening exercise was a general talk on grasses. I had given a short list and asked the children to make it as complete as they could, naming all the common varieties in the neighborhood. We not only discussed the valuable ones, but the pests as well.

The return of the birds naturally furnished some more delightful oral and written language lessons. The third grade made bird booklets and decorated the covers with free-hand paper cuttings of birds. They wrote descriptions of common birds and copied a few choice poems and verses. One story that they especially liked was the story of Louise Alcott when she wrote her first poem, "To A Robin." The booklets were illustrated with miniature bird pictures in colors.

In the fall we continued our work along these same lines. We collected and kept in one corner of the school room the seeds and fruits of all the plants in the neighborhood. Not merely the fruits of our fruit trees, but fruits of every weed, wild flower, farm crop, or tree. The result was surprising. No one even supposed that the witchhazel, teazel, wild ground cherry, black osier, false Solomon's seal, dog-berries and many others lived any nearer to us than in the land of story books. Some of the brightest pupils did not even know that wild roses had beautiful shiny hips or that pine cones had little winged seeds.

People in the district helped in the collecting until quite a

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museum was started. The children label, arrange, and care for the specimens and so feel a responsibility in the work.

I attribute the success of our work to the perfect freedom the children have had in the work. I saved all poems, pictures and articles that would be of value and let the children study them in the five or ten minute periods before recess or at noon when there was no necessity for preparing the next lesson. The material was always before the children. I never compelled them to do the reading, I merely suggested and left the decision with them, but they were always eager for the chance. There are a great many national and state bulletins sent free that furnished valuable reading.

Aside from the oral and written compositions nothing was required. Do not attempt to crowd in many technical terms. Let the pure, simple charm of the study be the controlling motive. It is there, and those who seek may find it, and use it to unlock a world of knowledge and quicken the power of observation.

Quincy, Michigan.

The Tobacco-Worm and Its Kin

ELLEN ROBERTSON-MILLER.

The changing of a tobacco-worm into a beautiful, big moth with velvety wings, is one of Nature's fairy-like achievements. This strange transformation can usually be observed, with little effort, where tobacco, tomatoes, or potatoes are grown. But if these plants are not accessible, the larvae may be seen upon jimson-weed, a plant which takes root and flourishes on the rubbish heaps of our city lots.

There are two varieties of the insect, both of which are commonly spoken of as the Tomato-worm, the Potato-worm, or the Tobacco-worm, according to the larva's feeding habits. One variety, *Protoparce carolina,* is found largely in the tobacco fields of the South, while *Protoparce celeus* is the more common Northern species. The two varieties, sometimes living close together, differ slightly in appearance, although their general characteristics are similar.

I have gathered eggs of both *celeus* and *carolina* from the same tomato plant and at the same time, those of *celeus* being oval and those of *carolina* ovoid.

A moth mother in ovipositing usually places but a single egg upon a leaf. At first the egg has a green color, but this

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JIMSON WEED.

changes to yellow before hatching. The egg period averages about seven days. When the little crawlers emerge they begin life by eating holes in very tender leaves. While they are ravenous feeders, the inroads which the caterpillars make on the tomato or potato plants is rarely serious, for while the so-called "worm" eats both green and ripe tomatoes, it lives chiefly upon the foliage, and this, as a rule, is sufficiently abundant to nourish a few insects without sapping the vitality of the plant. When present in numbers, however, they damage the tobacco, because the leaves of the plant and not its fruit constitutes the crop.

The caterpillars are nocturnal in their habits. They feed for about a month, during which time they undergo several molts. When fully grown they measure from three and a half to four and a half inches in length. With the exception of an occasional black or brown specimen, all have green skins, surprisingly like the shade of the plant on which they feed. They have large spiracles, or breathing holes, along the sides of their bodies, and each flaunts its caudal horn—that of *carolina* being reddish and

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that of *celeus* blue-black. The obliques on the sides of the caterpillars differ also. Those on *celeus* are yellow and supplemented by horizontal lines, which form a triangular figure on each abdominal segment; those on *carolina* are white edged with black, and there are no horizontal lines on this insect.

When resting, both species assume a sphinx-like attitude, but if annoyed or angered they throw the front portion of their bodies from side to side and spit out a green liquid, which is not poison but undigested food. The "horn" of the caterpillar being soft and without an opening, has neither the power to sting nor eject poison, newspaper stories to the contrary. The larva is perfectly harmless aside from the damage which it does to vegetation.

We find that when the plans of Dame Nature are left undisturbed by man they are so adjusted that each organism fills the place allotted to it, and with such nicety that no one form of life will, either from lack or over-supply, throw the great whole out of balance. On every plant and animal live other organisms which tend to control the growth and development of their host. Among the natural enemies of the Tobacco-worm and its race are the little Braconids, tiny winged creatures that deposit their eggs under the skin of a caterpillar. Here the eggs hatch into maggots and feed upon the tissues until they no longer require nourishment.

When fully grown these parasites come to the surface and each, standing upon its caudal extremity, begins to weave a fairy structure of pure white silk, the cocoon in which it is to await the development of its small wings.

The rapidity with which these wee creatures emerge and envelop themselves in their cocoons is surprising. I have fed an apparently healthy caterpillar and in two hours found it literally covered with these Braconid cradles, that by many are erroneously believed to be the eggs of the insect.

It is not wise to kill such a "worm," for the parasites will be ready to fly from their cocoons in about three days, and if allowed to do so many another big caterpillar will be obliged to serve as "bed and board" for their descendants, while the larva that nourished them, already exhausted by their feeding, soon perishes.

Where the Braconids are not sufficiently numerous to keep down the Tobacco-worms, Dr. Howard, the government entomologist, advises the destruction of *solanaceous* weeds—natural food-plants—from the margins of fields where tobacco is grown,

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clean cultivation and, when necessary, hand-picking. He also suggests that it might prove feasible to grow a few clumps of jimson-weeds in or near the fields as trap crops for the caterpillars, the plants to be thoroughly poisoned in the early summer before the tobacco is set out. Another method of dealing with the caterpillars when they become real pests, is the application of Paris green, either dry or in liquid form.

Fortunately a few tomato-, potato- and tobacco-worms evade their foes, and so enable us to learn how they burrow into the ground, and pupate within an earthen cell. The record of my observations on one specimen reared from the egg shows that the caterpillar went below on the thirtieth of July. Seven days later, when I broke through the cell wall that surrounded it, I found that the pupa had just emerged from the larva skin. It was still green and soft, with the head projecting forward and the limp tongue-sheath flat upon the wing covers. During the next three hours, however, the pupa gradually assumed the characteristic "pitcher" form, with its gracefully curved tongue-case handle.

It is not unusual to plow or spade up these brown "pitchers" in the late fall or early spring. If a specimen is kept until the moth emerges, the moth will be found to have a very trim and tailored appearance. The wings and body of *celeus* are gray in color with touches of vivid yellow and black along the back, while *carolina* has brownish scales among the gray. The eyes of both are prominent, the antennae stiff and club-shaped, while the tongue when uncurled measures from three and a half to four and a half inches in length.

The insects in their adult form are called "hawk" or humming-bird moths, because they fly with the strong, swift move-

THE "PITCHER" TOMATO WORM.
(Pupa cone, natural size.)

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ments of the hawk and poise above the blossoms as do the humming-birds. Unlike the silk moths, they have well-developed mouth-parts, and their tongues probe many a narrow corolla which opens after the butterflies have gone to sleep.

As the insect flutters hither and thither, sipping the sweetness that is offered by the flowers, it pays for its treat by carrying load after load of yellow pollen to the ripened and waiting pistils of other blossoms—blossoms that we should be sorry to lose from our gardens, but which, without the moth's aid would be obliged to alter their floral arrangement or become extinct. Truly,

> "More servants wait on man
> Than he'll take notice of. In every path
> He treads down that which doth befriend him."

You should have heard him speak of what he loved; of the tent pitched beside the talking water; of the stars overhead at night; of the blest return of morning, the peep of day over the moors, the awaking birds among the birches; how he abhorred the long winter shut in cities; and with what delight, at the return of the spring, he once more pitched his camp in the living out-of-doors.—Robert Louis Stevenson.

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Book Reviews

Outlines of Evolutionary Biology, Arthur Dendy, University of London. P. xxxix+454. D. Appleton & Co. $3.50.

This is a very readable and well balanced book. The author is a zoölogist and yet enough of plant evolution is given so that the reader realizes that evolution is a biological, not a zoölogical problem. The book is as nearly up-to-date as can really be expected in a subject advancing with such rapidity as biology. New facts are coming to light so rapidly that only current magazines can represent the real status of biological thought. Part I is devoted to the Cell Theory; II, the Evolution of Sex; III, Variation and Heredity; IV, Theory and Evidence of Organic Evolution; V, Factors of Organic Evolution. In the last part, when presenting the views of the earlier biologists, extensive quotations are made from Buffon, Erasmus Darwin, Lamarck, Charles Darwin, etc., making these chapters among the most valuable.

The author believes "that suddenly and exceptionally acquired characters, such as mutilations, are occasionally but rarely inherited, while, * * * characters which are due to the continued action of some external stimulus * * * become so firmly impressed upon the organism that they affect the germ cells as well as the somatic cells."

The book can be commended as one of the best outlines of evolutionary problems, perhaps the best, that has yet appeared in the compass of a single volume.

Trees in Winter, A. F. Blakeslee and C. D. Jarvis. 445 pages. The Macmillan Co. $2.00.

There are two parts to this book. The first is on the "Planting and Care of Trees"; the second, "Identification of Trees." In Part I are found an interesting chapter on "Structure and Growth of the Tree," ingenious devices for measuring the height of a tree, and all sorts of tricks of the trade in transplanting and caring for trees. Here are suggestive lists of trees and shrubs for ornamentation with planting plans for the yard. Injuries and insecticides have ample treatment.

Part II contains the keys for identification and the descriptions of species. The keys are based on bark, twig and bud characters and are exceedingly convenient. The descriptions are accompanied by superior illustrations. The whole book is amply illustrated. The book can not receive too warm commendations;

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it is invaluable to the student of our trees native to northeastern North America.

General Science, Bertha M. Clark. 363 pages. American Book Co. $0.80.

A text book in general science is a rather new thing and correspondingly difficult to write. This difficulty arises mainly from the abundance of material and the doubt as to which should be excluded. The fields of all the sciences are open for use and as yet there is no common consent regarding the appropriateness of particular materials, such as prevails in some measure in the specialized sciences.

In this case the material has been selected largely from chemistry and physics. Only four chapters out of a total of thirty-five, are principally biological, and physiography seems not to be represented in any important way. The sequence of chapters is largely that which obtains in texts of physics. The chapters are in general well written but rather brief averaging less than ten pages to the chapter.

While the book cannot be accepted as an ideal text in general science, it will serve a useful purpose. It is adapted to use in the first year of the high school or in the upper grades of the elementary school.—W. L. Eikenberry.

Agronomy, A Course in Practical Gardening for High Schools, Willard N. Clute. P. xvi+296. Ginn & Co.

This book can almost be read by its illustrations. They are numerous, well selected and clear. The text is well written and is a brief, well motivated presentation. If the teacher will use the practical exercises appended to the chapters first and the text as supplementary reading the book will serve an excellent purpose.

The early chapters on the soil seem particularly good. There follow several on the organization and activities of the plant. Then Chapter IX is on Garden Making, X Tillage, XII Weeds. Propagation, Pruning, Decorative Planting, Plant Diseases and Pests are other chapter headings. Plant Breeding is given fourteen pages; the Origin of Specie, five. It is questionable if even a high school senior can gain a clear notion of the present status of the origin of species in so brief a treatment.

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THE NATURE-STUDY REVIEW

DEVOTED PRIMARILY TO ALL SCIENTIFIC STUDIES OF NATURE IN ELEMENTARY SCHOOLS

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A Lesson on Squirrels and Chipmunks for Elementary Grades

ANNA BOTSFORD COMSTOCK

Children are constantly observing life out-of-doors and teachers have found it difficult to utilize these observations in the school

The Gray Squirrel *Photo by A. A. Allen*

work because they are desultory and unrecorded. We have been for years trying to bring into the schoolroom this fresh and rich material and make it an organic part of the nature-study work. This can be accomplished only by arranging the desultory

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observations so that they may be consecutive and systematized to form a complete story.

In this work the field note-book is the greatest possible help. If the pupils have the note-books they will describe what they see while they are seeing. This adds greatly to their powers of observation and is also most excellent drill in writing English.

The squirrels and chipmunks are attractive subjects for September study. At this time of year these active little creatures are happy gathering nuts and busy putting them away; each in his own fashion. Those pupils who get their nature-study in city parks are likely to study chiefly the gray squirrel. But, fortunately, these beautiful animals are quite as interesting and "squirrelsome" in their behavior as are their smaller wild cousins, while in country places the red squirrels and chipmunks are sufficiently common as to be easily observed by the children on their field excursions. On the Great Plains the striped gopher might be substituted for the chipmunk. In case a locality has only one species, this may be studied by itself.

The following plan has been found practical and the children seem to have greatly enjoyed the work:

The lesson begins with a discussion between the teacher and pupils as to how many squirrels there are in a locality. The first part of the lesson is given to distinguish these species. The following questions may be written on the blackboard for the children to copy in their note-books or to get firmly fixed in their memory:

1. What is the difference in size between the red and gray squirrels? or between the red squirrel and chipmunk?

2. Describe each carefully as follows: Note the colors of the ears, top of the head, sides of the head, nose, back, sides, breast, the under parts, the legs, and the tail.

3. Describe in detail the stripes on the chipmunk and tell just where they occur on the animal.

4. What are the differences in size and color between the tails of the red squirrel and the chipmunk?

It might seem that the above questions were very simple but there are very few grown people, who have known these animals all their lives, who can give an accurate description of their colors. There are very few people, for instance, who have noticed the dark stripe along the side of the red squirrel where the tawny color of the sides meets the whiter under parts.

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The next lesson should be on the habits and the following questions may be asked:

1. Are the front legs as large and strong as the hind legs? Does this mean that the squirrel is a good jumper?

2. Does the squirrel trot along or leap when running on the ground?

3. When crossing an open space does it stop at intervals to make observations? Describe its attitude when doing this?

The Chipmunk *Photo by A. A. Allen*

4. Describe how the squirrel climbs a tree. Does it keep its feet under it as when running on the ground or does it spread the legs out widely?

5. Does it go down a tree head first? Is it able to climb out on the smallest branches?

6. Does the squirrel follow the same route always when passing from one tree to another, either on the ground or the branches?

7. Does the chipmunk climb as freely in the trees as the red squirrel? Have you ever seen a chipmunk in the top branches of a tree?

8. What do the squirrels and chipmunks eat during the autumn, winter, spring, and summer?

9. Does the chipmunk carry its food in the same way as the squirrel? (This should bring out the fact that the chipmunk has cheek pouches while the red squirrel carries the nuts in its

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teeth.) Where do they find their food? Describe their attitude while eating it. Have you ever seen one wash its face?

10. How does the squirrel express excitement, anger, or joy?

11. How does the squirrel's language differ from the chipmunk's language?

12. Describe or sketch the tracks made by the squirrel.

13. Where do the squirrels spend the winter? The chipmunks? Where do each lay up their winter stores?

It is possible that the children may not be able to find for themselves the nests of the squirrels. In case one should make these observations, he should tell his story to the class. However, the homes of these animals may be written up by consulting books and may be a part of an exercise in English. In fact, the best way to round up a lesson after the children have made their observations is to let them read all that they can find about these animals and write the story. The summer nests of the squirrels made in the tops of trees and their winter nests in protected places, like hollow trees, and the chipmunk's cave with its protected entrance are all excellent topics for exercises in English.

The following books may be consulted: "Squirrels and Other Fur Bearers," John Burroughs; "Wild Life in Orchard and Field," Ernest Ingersoll; "Little Beasts of Field and Wood," Cram; "Familiar Wild Animals," Lottridge; "American Animals," Stone & Cram; "Secrets of the Woods," Long.

Children's Interests in Nature Materials

GILBERT H. TRAFTON

[EDITOR'S NOTE. The following article by Mr. Trafton appeared in 1904 in a local publication of practical studies in Passaic Public Schools. It deserves a wider publicity among those interested in nature-study.]

The child is Nature's direct product, developing and evolving for unknown ages from the lowest form of animate and perhaps inanimate creation. When the product is finished and the child comes into cognizance of that Nature of which he is a product, what shall be his relation to his ancient mother? The characters which first appear in the child and many of later developments are heritages from this Nature, some good, to be encouraged,

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others bad, to be repressed. Nor should we forget that the child comes by both characteristics as a result of his inheritance and is no more to be blamed for the latter than for the former. The first instincts of the child show his kin to Nature. The child desires to be put out in the open air, and where circumstances allow, he grows up with his pets, the plants and the wild animals. In thickly crowded cities, untoward surroundings tend to check this natural tendency, but it still manifests itself, though repressed.

After a few years of this free life, the child is introduced into our system of civilization through the educating agencies of our republic, partly in the home, chiefly in the schoolroom. Oftentimes this change has been abrupt and the child has been almost rudely torn away from his early attachment, and no opportunity is allowed for contact in later years with those phases of nature with which the growing child and youth ought to be in touch as he develops into manhood.

The development of the child and the demands of our civilization necessarily require the child to spend a large amount of his time in preparing to become a part of that civilization, but just as truly do they demand that these ties which bind the child to Mother Nature shall not be entirely broken, but that these chords from Nature's heart shall be fastened more securely to the child's life in order that through them may be absorbed the inspiration that Nature can furnish. How to teach Nature so that these ends may best be accomplished is the problem that teachers are now solving.

To make a local study of some of the problems involved in the relation of Nature and the child, questions were sent to the four upper grades of the Passaic schools to be answered by the children. Altogether the papers of a little less than one thousand children have been examined in preparing the results tabulated below. The questions sent out were formulated with two special objects in mind, first to test the children's knowledge of animals and plants, and second, to see Nature from the child's standpoint. The first object was easily attained and the results are of local interest as matters of information, but they also may suggest the subject-matter which should be taken up in Nature teaching in the Passaic schools. The second object was much more difficult of attainment, but the results may be of more than local interest.

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and also may suggest some important principles of Nature teaching, although one must be cautious about drawing any very general conclusions from so limited a study of local conditions. In the discussion of these results it will be understood that the conclusions drawn are intended to apply only to the cases examined, although perhaps more extended study in other schools may show some of them to be of general value.

The questions sent out to the children were divided into four sets, the first dealing with the children's knowledge of individual animals and their noticeable characteristics, the second with the children's likes and dislikes among the animals, the third doing about the same for plants as the first two for animals and the fourth dealing with the children's conception of animal intelligence.

First Set of Questions

1. Make a list of all birds, insects and other animals that you have seen living in Passaic. (Do not name animals that you may have seen in a menagerie.)

2. Describe briefly the one most noticeable thing about each.

It was found necessary to insert the explanation put in parentheses in the first question, as in a previous set of questions sent out without restriction the lists were made up very largely of menagerie animals.

In studying the results comparisons have been made along two lines, age and sex. The general results are shown graphically in the figures but a few answers are given verbatim.

"The most noticeable thing I know about a blue-bird is that he is blue and that if you kill him you get $25 fine."

"The most noticeable thing I know about a yellow-bird is that when he sits on a thistle, he does not prick his legs."

"Man—Sivilised annimal."

"Fly—has compressed eyes and for me they are no use."

"The most noticeable about the mosquito is it bits and has no teeth, about the fly is it sticks on fly paper."

"The most noticeable thing about the Donkey is he won't do any work as soon as he knows it is time to eat."

"The most noticeable thing about a grasshopper is that when you hold his head under water he does not drowned."

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"We keep dogs for tramps, cows for milk and cats for mice."
"A colt is a animal jest born."

In the figures the sexes may be contrasted by comparing the two lines, and the different grades by following the lines across the figures, in which the vertical distances represent per cents of all the answers which apply to the subject under consideration. Figures I and II and tables 1 and 2 indicate the results from the second question showing the various characteristics that appealed to the children. In making figure II all these features which relate to the appearance of the animal are represented by one line and those which relate to its activities by the other line.

TABLE ONE.

Grades;	4th	5th	6th	7th
Boys,	27 per ct.	13 per ct.	14 per ct.	7 per ct.
Girls,	33 "	7 "	11 "	13 "

The color of animals as the most noticeable feature.

TABLE TWO.

Grades:	4th	5th	6th	7th
Boys,	14 per ct.	2 per ct.	3 per ct.	3 per ct.
Girls,	10 "	4 "	4 "	5 "

The size of animals as the most noticeable feature.

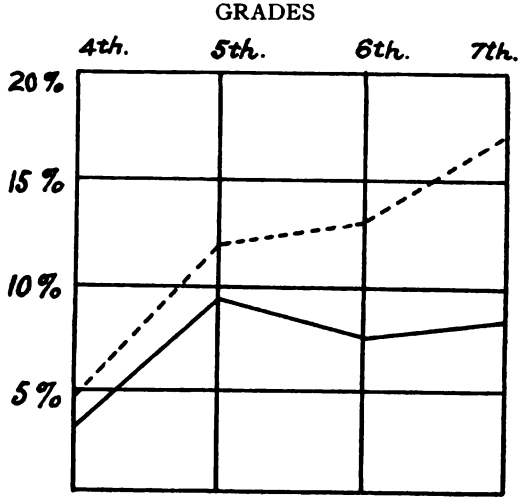

FIG. I. Sounds made by animals as the most noticeable feature
Boys..... Girls.....

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It will be noticed from figure I that sounds (chiefly songs) appeal more to the girls than to the boys and that the contrast between them increases with age. Again, in comparing the sexes it was found that the breeding habits, modes of locomotion and habitat appealed more to the boys in every grade and that in general the activities of the animals appeared slightly more to the boys. In comparing ages, tables 1 and 2 show that color and size impress the lower grades more than they do the higher grades.

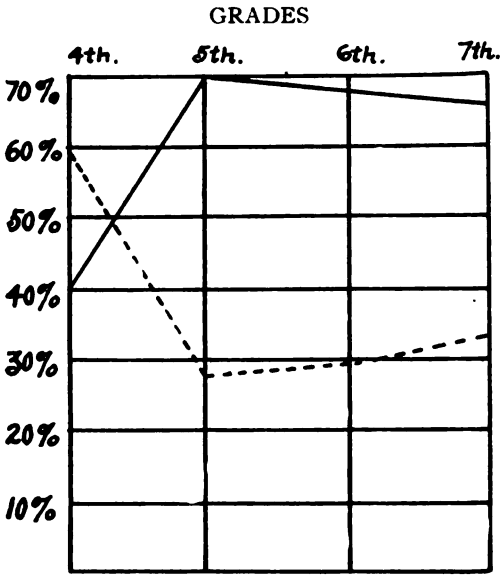

FIG. II. Showing how appearances and activities appealed to the children.
Activities..... Appearances.....

From figure II it will be noted that in the three upper grades the activities of animals appeal much more strongly to the children than does the mere appearance, and that in the lowest grade it is still an important factor. The more prominent activities mentioned referred to the feeding habits, modes of locomotion, habitat and sounds made.

In the lower grades there was a marked correlation of ideas, of size with color and of locomotion with habitat. Taken in connection with the fact that these were the characteristics which appealed most strongly to these grades, it is quite likely that this represents the limit of the children's knowledge: they simply told about all they knew concerning the animals, which was summed up in these two features. In the higher grades there was very little of this correlation.

SECOND SET OF QUESTIONS.

1. Which animals do you like best? Tell why.
2. Are there any animals living in Passaic which you dislike? What are they? Why do you dislike them?

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3. Write the most interesting thing you know about any animal.

"I like the cat best. Because his fur is so nice and he squeels if you pull his tail."

"There are some animals in Passaic which I hate. They are the cats, rats, mice and snakes. I dislike the cats because on some winter nights when they are outside they mew so that you can't sleep. I dislike the rats and mice because they are troublesome. And snakes when they bit you their bites are poisonous."

"I like the sheep because it has wool. Yes I do not like the pigs because they have such a big mouth."

"I dislike a masheytoe (mosquito) because he is always biting, and when he bites it tikles so."

"There are animals in Passaic which I do not certainly like at all. They are the hogs and pigs, rats and mice. They are very annoying, and I do not like hogs and pigs because they are so hoggy and dirty."

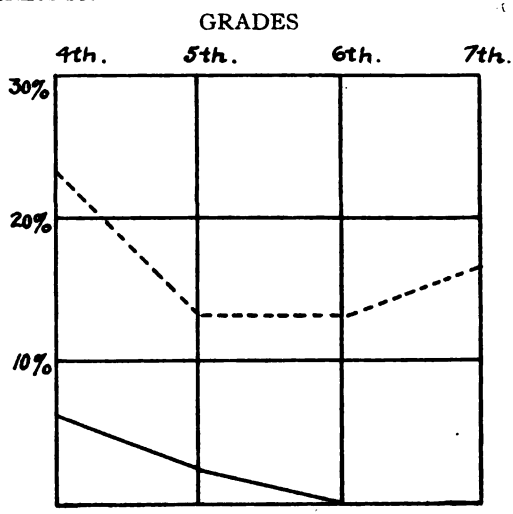

FIG. III. Showing how a pleasing appearance appeals to the children.
Boys..... Girls.....

The favorite animals were the following in the order named: Dog, horse, cat, wild birds, rabbit. Birds and cats were greater favorites with the girls than with the boys. The greater preference for birds is doubtless explained by the fact that songs appeal more to the girls, the greater preference for cats by the fact that these animals are house pets. There was only one pupil, a girl who did not like any animal.

Following are the reasons given for the preferences in the order named: usefulness, gentleness, faithfulness, intelligence, caring for people and saving life, pleasing appearance.

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As figure III shows, a pleasing appearance appeals much more strongly to the girls than to the boys and more to the lower than to the higher grades, which agrees with the results of the first set of questions. Usefulness and faithfulness appealed more to the boys and the saving of life to the girls, while the results of these questions agree with those of the first set in showing that sound appeals more to the girls. In comparing grades it was found that in the higher grades less attention was given to the practical consideration.

Below is the list of animals disliked arranged in order: mice and rats, snakes, cats, dogs, mosquitoes, pigs. One-fifth of the children, 60 per cent of them boys, wrote that there was no animal they disliked. The reasons for these dislikes in the order given were: they injure people, cause annoyance, have an unpleasing appearance, eat things, chiefly food, and are unclean. The great reason assigned was that the animals do some personal harm in all gradations from the scratch of the cat up to the supposedly deadly sting of the snakes, but this fear was less prominent in the upper grades.

But the most noticeable thing in this set of answers was the fact that the reason given for disliking the wild animals, chiefly snakes, is entirely unfounded, that is, that they are poisonous. As a matter of fact there are only two or three snakes found in this latitude whose bite is poisonous and these are so rare that it is exceptional to find anybody who has seen them wild in nature. It certainly seems as if the feeling of the human race toward the snake as depicted in the myth of the Garden of Eden has been well maintained, but even if the repugnance felt toward these animals is not overcome, the children should at least be taught the truth regarding the human relations of these ill-treated animals, many of which are of economic value in destroying insects.

In answering the third question nearly the same animals were mentioned as in the previous questions: the dog, the horse, the squirrel, the monkey, the cat and wild birds. The interesting characteristics given may be classed under the following heads in the order given: intelligence, usefulness, appearance, saving life, and song. The answers show results similar to those of the previous answers in that the practical value appeals more to the boys and the song more to the girls.

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Third Set of Questions.

1. What interests you most about a plant?

2. (a) Make a list of the trees that you know. (b) Make a list of the flowers that you know.

3. Which flower do you like best? Why?

The flower was the most interesting feature of plants, being given in 57 per cent of the answers, the growth of the plant in 15 per cent, the bud in 3 per cent, the leaf in 8 per cent. There was practically no difference in comparing either the ages or sexes.

In grouping the list of trees and flowers, two divisions of each have been made, the cultivated and the wild, the cultivated trees including the fruit trees. The total average shows that 61 per cent of the trees known are wild, while in the case of flowers the ratio is just about reversed, the wild forming 41 per cent, and the cultivated 59 per cent.

In the lower grades the lists of both the trees and flowers are about equally divided between the wild and cultivated, but in the higher grades the per cent of wild trees is larger, while that of the wild flowers is smaller.

The lists of favorite flowers seemed to indicate that the children were not able to distinguish between the different kinds very closely as the great majority of flowers were roses to the children. The two things about the flower that appealed to them were the fragrance and the color, the same things that the flower has developed to please the insects. In many cases both of these characteristics were mentioned by the same child. The choice between the two is very evenly and uniformly divided as regards both the sex and the grades. The total average is 45 per cent for appearance, chiefly color, and 49 per cent for fragrance.

Fourth Set of Questions.

1. What animal after man knows most? Give reasons for your answer.

"A monkey after a man knows most. Because man was first adopted from the monkey."

"The animal I think knows most is the monkey because it can imitate a human being and that shows he must have sense."

"I think the dog and the horse knows the most because they are around where the people are all time."

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"The animal after man knows most is the Parote, the reason is it can talk. The only difference in a Parote and a man is it has feathers and a bill instead of a nose. it has feathers instead of cloths."

"I think the horse knows most because I have seen a horse in a show dance to music. Dogs are intelligent but they do not seem to have an ear and time for music the way this horse had."

"The monkey is the animal most like man, and it knows most. I saw a monkey turning a toy churn, when his master did not look why he took a rest. But when the man looked back the monkey started again."

"The horse is after man in his intelligence. In the circus horses dance to the music and they do it with thought."

"A monkey knows most next to man. A man was taken from a monkey."

TABLE THREE.

Showing children's ideas of the most intelligent animals.

Dog	Horse	Monkey	Parrot	Wild Birds
40 per ct.	32 per ct.	14 per ct.	6 per ct.	3 per ct.

TABLE FOUR.

Selection of the horse as the most intelligent animal.

Grades:	4th	5th	6th	7th
Boys,	68 per ct.	38 per ct.	26 per ct.	22 per ct.
Girls,	38 "	34 "	32 "	0 "

The following animals were mentioned which are arranged in the order of intelligence as interpreted by the children: dog, horse, monkey, parrot, wild birds. Table 3 shows more exactly the relative standing. The animal chosen seemed to depend to some extent on the grade. This was especially marked in the case of the horse, table 4, which appeals less to the higher grades, its place being taken largely by the dogs.

The reasons assigned for considering the various animals intelligent are of interest, not, or course, as bearing at all on the actual intelligence of the animals concerned, but as suggesting the child's conception of intelligence. Following are the reasons given. with the per cent in each case; ability to perform tricks, 28 per cent; ability to understand what is said to them, 21 per cent; caring for people and saving life, 18 per cent; actions similar to man's, 10 per cent; evidence of memory, 6 per cent; ability to avoid danger, 3 per cent.

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TABLE FIVE.

Ability to understand talk as a sign of intelligence.

Grades:	4th	5th	6th	7th
Boys,	25 per ct.	12 per ct.	13 per ct.	5 per ct.
Girls,	15 "	48 "	23 "	28 "

TABLE SIX.

Ability to perform tricks as a sign of intelligence.

Grades:	4th	5th	6th	7th
Boys,	58 per ct.	22 per ct.	29 per ct.	54 per ct.
Girls,	25 "	9 "	12 "	27 "

TABLE SEVEN.

Acting like a man as a sign of intelligence.

Grades:	4th	5th	6th	7th
Boys,	0 per ct.	15 per ct.	9 per ct.	30 per ct.
Girls,	8 "	17 "	15 "	9 "

TABLE EIGHT.

Saving and caring for people as a sign of intelligence.

Grades:	4th	5th	6th	7th
Boys,	16 per ct.	12 per ct.	15 per ct.	10 per ct.
Girls,	33 "	8 "	22 "	37 "

TABLE NINE.

Memory as a sign of intelligence.

Grades:	4th	5th	6th	7th
Boys,	0 per ct.	12 per ct.	7 per ct.	9 per ct.
Girls,	0 "	3 "	5 "	0 "

Tables 5–9 show the summary of these results, from which it appears that the saving of life and the ability to understand the human language impress the girls more than the boys; while the ability to perform tricks appeals more to the boys. This last contrast may doubtless be explained by the fact that the boys have probably attended the circus more frequently than the girls.

The results obtained from all the material used may lead to a few general suggestions regarding Nature teaching. One thing stands out prominently, the limited acquaintance of the children with the wild plants and animals. The average number of wild animals named was 11; of domesticated animals, 7; of cultivated trees, 4; of wild trees, 6; of cultivated flowers, 6; of wild flowers, 3. The various answers were confined very largely to a few domesticated animals, showing an ignorance of wild life, but it is only through an acquaintance with this wild life that one may expect to acquire a true sympathy with Nature. Special attention may well be given to introducing the children to a few of the many common inhabitants of Nature's realm.

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In a more general application we may note that one of the chief problems which the teacher has to solve is to adapt the subject matter to the capacity of the child. Now the results of the first set of questions showed that the lower grades were much impressed with the color and size of animals. But it must not be supposed that this is to be taken as an indication that in these grades the study is to be confined to the mere consideration of size and color. The significance of this is that these features may serve simply as an entering wedge to interest the child and to introduce to him Nature's inhabitants, which should then be studied from the standpoint of their life activities, such as their feeding habits, mode of locomotion, habitat, use to mankind, songs and sounds, rearing of the young and other related topics, by means of which the interest may be maintained and increased. That the children noted the color and size more in the lower grades and the activities more in the upper grades is, without doubt, an index of the children's knowledge. The younger ones were restricted largely to a knowledge of the mere appearances, while the older ones had been learning more about the habits of the animals; and that the children as soon as they came to know more about animals showed the tendency to be more impressed by their habits and other activities, shows along what line the interest of the child is to be chiefly aroused, that is through life, which forms the keynote to Nature and Nature-study.

A Wild Flower Garden

NORMAN E. NELSON.

(Read before Nature-Study Club of Rockford, Illinois, April 14, 1913.)

If you are a lover of the flowers and ferns of wood and field, then by all means have a wild flower garden, provided you have a spot of ground shaded at least a part of the day from the burning rays of the sun. There may be various kinds of wild flower or fern gardens. A very attractive one of ferns alone could be made. You may have one of orchids, one of composites, of flowers that bloom only at one season, or flowers of one color. But I will endeavor to treat only a general wild flower garden such as we have at our home.

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We devote considerable space to flowers and vegetables, and we enjoy them all, but from earliest spring to latest fall it is the wild flower garden which attracts us many times a day and seems always ready to reveal to us something new. I was requested to tell how to have a wild flower garden.

From personal experience we have learned that location and soil are of the greatest importance. The garden should receive sunlight at least two or three hours each day but for the remainder of the time it should be protected, since the wood-land plants

FIGURE 1.—Our Hepaticas. (The sunken board is shown)

which always grow in shade would be injured. Besides the sun dries out the earth too fast and keeps the plants too hot. The soil should be neither stony nor sterile. If rich leaf-mould can be secured, use it by all means. If it is not available use good black soil.

Our first attempt at a wild flower garden was in a small space on the north side of a board fence about five feet high. What few specimens we had at that time grew splendidly for several summers. But one day our neighbor, the owner of the fence, decided to have it removed and then our wild flower garden was left the greater part of each day with no shelter from the sun's rays, and the flowers began to show the effects very soon.

Sometime later we secured the vacant lot to the north of us and that afforded us a much larger strip of ground and on the north side of another board fence, soon we began a wild flower garden anew. We laid out a bed about thirty feet long by four feet wide and to keep the grass of the lawn from spreading in, we

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sank inch boards all around the front edge. We transplanted the plants from the first bed. Then we began to add little by little as we were fortunate enough to secure new species.

On the fence we have a mammoth woodbine which not only serves to hide the fence but provides a much cooler background than the bare boards would when heated by the sun. By trimming and training it is kept from interfering in any way with the garden.

Bordering the fence are the ferns, the lady fern, the maidenhair, the fragile bladder, the woodsia, and the sensitive ferns.

The first flower to appear is the hepatica. It is most interesting to watch them push their little furry buds up through the ground and last years leaves almost before the frost is out. We have them in many shades, pure white, cream, light and deep pinks, lavender and blues from the lightest to the darkest tints.

> "Blue as the heaven it gazes at,
> Startling the loiterer in the naked groves
> With unexpected beauty; for the time
> Of blossoms and green leaves is yet afar."

Some of the plants have double, some single flowers. The bees are attracted to them by the odor and collect the nectar and pollen. The young blooms close as the sun begins to set and open between eight and nine in the morning with the exception of cloudy days when they remain closed. When the flowers grow old and begin

FIGURE 2.—Bloodroot

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FIGURE 3.—Bird's Foot Violets. (Natural size)

to fade, they remain open all the time. The hepatica is the herald of spring and you should make sure of at least a few of them in the garden as you will find much of interest in this very early flower. These last for some time and as they fade come the leaves which, with their many different markings, are beautiful in themselves.

Next to these come the bloodroots and from a few plants ours have multiplied until in early spring it is like a gradual upheaval of the earth as the buds force themselves through. One writer speaks of it as, "Snugly protected in a papery sheath enfolding a silvery-green leaf-cloak, the solitary erect bud slowly rises from its embrace, sheds its sepals, expands into an immaculate golden-centered blossom that, poppy-like, offers but a glimpse of its fleeting loveliness ere it drops its snow-white petals and is gone."

From Mrs. Porter,

> "It has blood in its root and a waxen-white face
> Coral stems and silver leaves of wonderful grace."

"In some rich, shady corner of the garden, a clump of the plants will thrive and bring a suggestive picture of the spring woods to our very doors."

Then come, the spring beauties and the dutchman's breeches. Thoreau observed that, ". . . only those plants which require but little light and can stand the drip of trees, prefer to dwell in woods—plants which have commonly more beauty in their leaves

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than in their pale and almost colorless blossoms. Certainly few woodland dwellers have more delicately beautiful foliage than. . ." the dutchman's breeches.

Soon appear the violets, white, blue, variegated, bird's foot, hand and yellow. The dog's-tooth violet is the only spring flower which resembles the graceful turk's cap lily in shape.

The pinky toothwort, whose root-stalk resembles a tooth, and the yellow bellwort arrive next. Imaginative Linneaus discovered that this flower hangs like a palate from the roof of a mouth and made its generic name accordingly. The rue anemone and isopyrum soon lift their pure white blossoms skyward from their ferny leaves.

"The Mandrake stoutly raises
Its silken umbrellas green,
To shelter pearl white flowers,
Apples of gold to screen."

(*Mrs. Porter.*)

The creeping and field buttercups push their little golden cups toward the sun and soon after the fringed avens present their feathery fruits to the winds for distribution. The red and white trilliums are now open. The latter nods its flowers as if in shame on account of some wrongs its ancestors might have done.

The wild geranium is one of the flowers which can only be fertilized by insects. Self-fertilization is impossible because the anthers fall off of the filaments before the stigmas mature. The Greek valerian tolls its fragrance on the breeze in May.

Blanchan tells us, "Like the wicked servant who buried the one talent entrusted to his care, the wild ginger hides its solitary flower if not actually under the dry leaves that clothe the ground in the still leafless woodlands, then not far above them." When the plant is bruised the odor is much like that of ginger.

The small-flowered false Solomon's seal is one of the daintiest blossoms we have. When closely observed the delicate structure becomes much more apparent. The plant appears clumsy for its blossoms. In the fall the fruit becomes banded with brown or red.

I have never had much success with the showy orchids. One year they blossomed but soon after they died out. Last year we procured a number of new plants which are now coming up. Anyone who is interested in orchids should add this flower to their garden. Although it is one of the most common, it is one of the most beautiful. The petals and sepals which form a hood

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are a mauve or pink and the lip and its spur are white. If a pencil or other instrument be thrust into the mouth of the spur, where the nectar is secreted, upon being withdrawn there will be found adhering to it two pollen masses which in a few seconds will bend

FIGURE 4.—Long-leaved Pink Phlox. (Natural size)

horizontally in order that the masses will touch the stigma of the next flower.

The Jack-in-the-Pulpits we procured unintentionally. The first ones were in some Hepaticas. The striped pulpit is so beautiful with the various shades of brown on a green background. In the fall the berries make the wild flower garden look more cheery with their crimson hue.

We have three of the native phloxes, the white phlox, the common blue wood phlox, the long-leaved phlox found in wet

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meadows and on higher land. The pink phlox is by far the most beautiful. The leaves are long and slender. The flowers are a delicate pink, with darker markings at the mouth of the corolla.

Our shooting stars are very prosperous. If I remember rightly last year on one of the plants there were about two dozen blooms; the flowers can be found in any shade from pure white to deep pink, light pink being most common.

Our blue flag thrives exceedingly well. It was an iris which Louis VII made the national emblem of France, calling it the *Flower of Louis* or *Fleur-de-lis*.

The red and yellow columbine is much to be admired. The ancients thought that the nectaries looked like a group of pigeons around a dish—a favorite device of ancient artists.

FIGURE 5.—Large, yellow Lady's Slipper.

Our much prized yellow lady's slipper has had an eventful life since coming to us. I found it in full bloom a number of years ago, but in getting it home the flower stem was broken. We planted it in our first wild flower garden and while there it grew but no flowers appeared. When we moved the bed we decided to take it also although it had ceased to be an object of beauty to us. One morning to our great surprise and unspeakable delight a bud was discovered and soon opened to a beautiful golden slipper. The next year instead of the flower a second shoot appeared. The following spring came the terrible April freeze and we discovered some time after to our sorrow a frozen bud on each shoot. The next year we were disappointed, but last year the older plant yielded for us a beautiful flower and for the first time it produced seed. This year if Jack Frost tries to cut up any pranks with our wild flower garden, we have a covering ready to shut him out.

The ferny but rough bed-straw grows up after the early flowers have gone. It makes an excellent green for small bouquets. Its tiny white flowers resemble a square. This plant should be included in all gardens. The Adam-and-Eve, an orchid, blossoms with the lady's slipper. The flower is inconspicuous. It gets its name from the corms of which there are always two, Adam and Eve, and sometimes more, the children and grandchildren. Peo-

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ple used to extract glue from the corm. The peculiar thing about this plant is the single leaf which comes up in the fall and dies the following summer.

The wild sunflower begins to bloom in the summer and lasts until the frost. Finding that our garden was outgrowing its bounds, last year we started a corner bed especially for field flowers. It is not advisable to put field daisies where they can disturb other plants as they spread very rapidly. In this corner we have planted the purple and white blazing star, the tuber of which is believed by some to be a cure for rattle-snake bites. We also have the butter and eggs, wild ageratum, Turk's-cap lilies, and the prairie white fringed orchid. The latter flower I found for the first time last summer. It is supposed to be found only in the original prairie sod.

FIGURE 6.—Prairie White Fringed Orchid

I tried an experiment with water flowers last summer which proved quite successful. I used a low galvanized can about eighteen inches in diameter. I first filled the can to some depth with black soil, in this the specimens were planted. Several inches of sand was then put over the soil, and the can filled with water. I planted dog-lily, arrow-leaf with its pure white bloom, and water cress. Among the leaves and stems lived three gold-fish and a tadpole which later became a toad and made his new home in the garden.

In transplanting from the woods and fields to your garden be sure to have a good ball of earth around the roots. Plant them as soon as possible after getting home, and keep them well watered until the roots are thoroughly established in their new abode.

I realize that I have brought to you but little that is new. However, if I have been able to arouse in you a greater love for wild flowers and ferns, and a strong desire for a garden of your own, I will feel that I have aided some in the work of the *Nature-Study Club*.

. . .

Since the preceding paper was read, I have made several important additions to the garden. Some pink lady's slippers, two

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pitcher plants and a couple of interrupted ferns were received from Maine. The pitcher plants are kept wet enough by a flower pot kept with water sunk between them. The Western wood lily and wild hyacinth have been started. The Green orchis (*Habenaria bracteate*) and one of the rattlesnake plantain are two most important additions.

A large bed of both the large and small-flowered yellow lady's slippers has been very attractive. I have been able to raise the pasque flower (*Anemone pateus* var. *Woflgangiana*), although it is a plant which greatly resists cultivation.

A wild flower garden is one of the most important possessions of any *Nature-lover*.

Ichabod, Foundling

S. Louise Patteson

He was the nursling of a Towhee pair, the only one of a brood of three that survived the pinfeather age.

Seated one July morning on the leaf-strewn ground beside his nest, he was the picture of wanderlust. But where were the parents? An hour elapsed, and neither returning, I took him to be deserted or forgotten, and carried him home with me. For he seemed too callow a youngster to brave the world alone.

A low Buckeye sapling satisfied his idea of a perch, and his periodic demands for food were appeased with berries, flies, ant larvae and grasshoppers. Whenever he had enough he sullenly closed his bill.

As his call notes grew louder he attracted other birds, notably Kingbirds who are known to go to the help of smaller birds in trouble. At every such attention his little black eyes sparkled with pride, and immediately he tried his wings to ascend. But having as yet made only lateral flights, every upward attempt ended in a flop to the ground.

When a Kingbird perched in the top of the Buckeye sapling, my portégé by easy stages succeeded in getting to him. But presently the Kingbird left him there alone and at the next feeding time he looked down so dejectedly, I held a long handled rake up in front of him on which he perched in all guilelessness and was brought down. Moreover, I had ransacked my brain for a name

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When he had enough he closed his bill.

nice enough for this child of my heart, and was not willing to let him depart a nonentity.

Meanwhile a neighbor called and demanded to know what this newcomer was.

"Why, a Towhee," I answered.

"A Towhee?" repeated the neighbor, with an incredulous inflexion.

I had noticed that my portégé was uncommonly large for a baby Towhee, and that instead of the light front and dark brown back of young Towhees his entire plumage was a mottled olive brown.

"Some lazy Cowbird"—the neighbor went on—"imposed an egg on your Towhee; for this is nothing but a Cowbird."

Recalling now the fact that a Cowbird had called insistently during the hour I waited beside the Towhees' nest, and knowing

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that Cowbirds do patrol premises where they have deposited eggs, and watch for a chance to get possession of their young, I was compelled to vote my supposed Towhee a Cowbird. And so much glory suddenly departed from him that instinctively I named him Ichabod.

When the Kingbird again coaxed him up higher, I let him stay. A few minutes later an adult Cowbird perched beside him, and after a bit of what seemed to be greeting, the two flew away.

Had the Kingbird told the Cowbird where he could find one of his foundlings?

A Course in the Natural History of the Farm

JAMES G. NEEDHAM

A chief function of nature-study is, and is to be, orientation. Youth must get its bearings in the world of nature. Rightly to gauge the fundamentals of one's relations to environment is no longer easy, for conditions have grown artificial. Getting one's living with a can-opener does not conduce to a true appreciation of sources in mother nature. It is fundamental for a sound basis of procedure through life that the sources of our livelihood should be rightly apprehended. Nature-study is the best corrective for the ills entailed by the artificialities of modern life.

The students who are coming to college show in recent years an increasing acquaintance with things out-of-doors—at least this is true in New York State, where I meet in my own class room a fresh lot of more than five hundred young New Yorkers every year. They know on sight, at least, a few more birds and trees and flowers than formerly, and they take an interest in some of the wonderful processes of nature, such as the metamorphosis of amphibians and of insects. Doubtless this interest is the result of the effort expended in late years in nature-study extension. The leaven is working. But these same students, even the best of them, show a lamentable lack of appreciation of any relation existing between their past nature-work and the practical affairs of life: still less relation between it and the studies in pure science which chiefly occupy the earlier years of their college course.

In the hope of helping to correlate these things, the writer, at the suggestion of Director L. H. Bailey, began in the spring

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of 1913 the preparation of a course on the Natural History of the Farm, and gave the course in the Fall to a class of over four hundred freshmen then entering the New York State College of Agriculture. It consisted of one lecture and one field trip per week. It proved very satisfactory. It kept the students out on the farm for half a day at least of every week, working with their hands on the things that grow there. It induced many of them to go back again and again to witness the changes of the season. The drama of life out-of-doors became more attractive than the vaudeville down town. For many of them it awoke new and wholesome permanent interests. Moreover, it proved an excellent supplement to other college courses, without duplicating the subject-matter of any of them. It was all frankly natural history, much of it of such elementary sort as might have been done in the lower schools. We did it in college because it had not been done and was needed.

The field work of the first week consisted for each student of a trip around the Cornell University farm, a blank map in hand, locating thereon all the principal crops, wild and tame, found growing there. In succeeding weeks different groups of natural products, each representing in the main important agricultural interests, were taken up: the list for the first term of 1912–13 being as follows:

1. The farm as a whole.
2. Wild fruits of the farm.
3. Wild nuts of the farm.
4. The farm stream.
5. Fishes of the farm stream.
6. Pasture plants.
7. Wild roots of the farm.
8. The November seed crop.
9. Deciduous trees in winter.
10. The farm woodlot.
11. Fuel woods of the farm.
12. Winter verdure of the farm.
13. Wild fowls of the farm in winter.
14. The mammals of the farm.
15. Farm landscapes.

It will be seen from this list that the course has to do with the sources of agriculture. The wild fruits, roots, fowls, etc., chosen

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for study are mainly the edible ones. Edible (and poisonous) or otherwise useful (or harmful) things were chosen throughout. Students have been encouraged to see that these wild things were once the only things available for human sustenance: to see that among them are many good things that man has as yet in no way improved, and to observe that variations in nature offer the same materials for selection and improvement as in the artificially propagated forms. So, while this course deals with natural history pure and simple, it is not the natural history of the whole range of things curious and interesting in nature, but rather of those things that human kind has chosen to deal with as a means of livelihood and of personal gratification in all ages.

Field trips in sections of twenty students with one instructor were conducted on appointed afternoons every week. No trips were omitted on account of bad weather, but the physically unfit were not registered for the course. Furthermore, three optional studies were offered any one of which might be done by a student privately and substituted for any one (excepting the first) of the fifteen regularly scheduled. These three optionals were done by many students in addition to all the regular work. They were as follows:

1. *A record of farm operations*—October to January inclusive. This was the student's own record of date and place and relevant weather conditions week by week through the term, together with what he saw the farmers doing, their doings being provided for in the blank furnished, under the following subdivisions: work with cereals, forage crops, root crops, fruits, timber crops, other crops, live stock, poultry, other animals, soils, roads and fences, domicile, and other activities, business, civic, social, and miscellaneous. This optional was not chosen by many students, few having opportunity to see what the farmers were doing. But the few who elected to keep this record, did it well and found it significant.

2. *Noteworthy views on the farm.*—"Best examples I have seen of: 1, a wide panorama; 2, a long vista; 3, a woodland aisle; 4, undulating fields; 5, a small sheltered valley; 6, a crop in the fields; 7, a meandering brook; 8, a pond scene; 9, a waterfall; 10, rocky cliffs; 11, a foliage picture; 12, a scene with farm animals; 13, a snow scene; 14, a homestead." The data concerning these "best views" called for is indicated by the table headings

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"For what selected," "Location," "Best seen from" and "At what time." The object of this study was to cultivate appreciation for the beauties of a rural environment.

3. *Noteworthy trees of the farm.*—"Best specimens I have seen of: 1, white pine; 2, hemlock; 3, cedar; 4, larch; 5, oak; 6, hickory; 7, chestnut; 8, butternut; 9, beech; 10, birch; 11, maple; 12, elm; 13, ash; 14, basswood; 15, sycamore; 16, tulip tree; 17, hornbeam; 18, flowering dogwood." Data called for concerning these "best trees" is indicated by the column headings "Chosen for" what particular excellence (symmetry, form of trunk, type of branching, color, etc.), "Location," and "Best viewed from." Also on this sheet was called for location of the best bit of pine, oak, elm and beech-woods, and best general forest cover. This optional was offered in the belief that no one knows trees until he knows individual trees.

These optional studies have one great merit that much of our assigned work sadly lacks. They encourage spontaneity of observation. The work is done without an overseer and oracle at hand, and done voluntarily. In the future I shall have more of them.

The two examinations in this course were held in the field. A few students trained to pass examinations of another sort complained bitterly that they did not know how to cram for these. Not even tutoring schools could help them. Knowing things in nature was very different from knowing words put down on paper.

Instructions issued contained the following statements:

"Specimens, such as have been studied in this course, will be on display in adjacent places in six groups, corresponding to the topics named. Members of the class will be expected to identify the specimens, and to give certain information concerning them.

Separate papers for each topic will be furnished by the instructors in charge. Each paper is to be completed and handed in on the spot before passing to the next place and topic."

It chanced that one of these examinations coincided with a heavy fall of snow which made writing in the field difficult. In the future I shall have in reserve a set of lantern slides made from good photographs of the real things. With these in hand much the same kind of a test may be given indoors.

The doing over and over of so much field work of like character in twenty sections, with the assistance of half a dozen instructors

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especially selected for their training and experience in field work, has given me an exceptional opportunity for trying out plans for organizing class work afield and for planning and testing the records of it that shall be required at the students' hands. It is arranged that I shall write of some of these matters for subsequent numbers of the NATURE-STUDY REVIEW. Let me conclude this introductory paper with a statement of some of the preliminary jobs that were done before the work was under-

An out-door examination was conducted as shown in this picture. The back-stops of a girls' playground in a sheltered place beside Cascadilla Creek were used for the display of the specimens that were to be identified and written about. The groups of students seen, are working at separate topics, and are passing from one topic to another without confusion following a numerical sequence.

taken. Several out-door class rooms were prepared at convenient places in the woods as meeting places for sections. Some plantings of wild things, and more pruning, were necessary. A path was needed here, a bridge across a brook there, a stile over a fence yonder. The banks of the best stream were too soft and needed ridging to make a place where students could approach the water in comfort. These little things are important, for it is just as necessary in the field as in the laboratory that every student shall be supplied with adequate materials and shall have a fair chance to use them when he gets them.

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Some Simple Experiments in Animal Behavior

W. C. ALLEE.

It is possible to illustrate the essential reactions of the lower animals in a simple manner and without expensive apparatus. The experiments here suggested will mainly involve crustaceans since thcir habitats and the methods of collecting them have been recently discussed in this magazine.[1] In general they can be worked with any small water animal and, with the obviously necessary adjustments, with any small land inhabiting animal as well.

In animal behavior the response of the organisms to a given stimulus is spoken of as a tactic response. In general, this means that the organisms react to the given stimulus in a more or less definite manner, but it expresses nothing regarding the presence or lack of orientation, the speed of the reaction or the detailed behavior by which the response is brought about. The names of a number of the tactic responses together with the stimuli causing them are as follows:

Reaction	Stimulus
Phototaxis	Light
Thigmotaxis	Touch
Thermotaxis	Temperature
Rheotaxis	Current of water or air
Geotaxis	Gravity acting as a stimulus
Chemotaxis	Chemical
Electrotaxis	Electricity

In all of these, the reaction is positive if the animal goes toward the source of the stimulus; if in the reverse direction, it is negative. If on the other hand the animal reacts to the stimulus but does not move in a definite manner as regards the stimulus, it must be classed as giving an indefinite reaction.[2]

In animal behavior, there is one golden rule of experimentation; that is, to vary one factor at a time, and only one. In order to test whether more than the factor under experimentation is varied, it is necessary to run a control experiment. Everything in the experiment and the control are to be exactly the same as far as can be told except for the one factor under experimentation.

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[1]Allee, NATURE-STUDY REVIEW, Vol. 9 No. 4.

[2]For a more complete discussion of these fundamentals of animal behavior see Holmes, *The Evolution of Animal Intelligence.* Henry Holt & Co. 296 pp. 1911.

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It follows that a difference in behavior of the animals in the two vessels must be due to the experimental factor.

The general conditions in both experiment and control should be sufficiently like the natural environment to permit the animals to behave normally. Granite ware pans are satisfactory and inexpensive as containers for animals during experimentation and they are not affected by the water. However, the bottom is often too slippery to allow the animals to react readily; when this is the case it should be covered with a layer of beeswax. Sometimes the corners will need to be rounded out with the wax to prevent the animals from collecting in them. For most of the experiments outlined in this paper narrow granite iron bread pans are entirely adequate, and the black paper in which photographic supplies are packed may be used whenever black paper is required.

Unless otherwise indicated, one inch of water should be placed in the pans for each experiment. Whenever possible the water should be taken from the container in which the animals are kept. If other water is used it must be approximately the same temperature as that in which the animals are living. If tap water is used it must be allowed to stand long enough for the gases with which it is supersaturated to escape. It is sometimes preferable to allow the water to stand over night in order that it may be perfectly free from bubbles. If the water is not allowed to come to air saturation the air bubbles often collect on the appendages of the animal being tested and interfere seriously with its reaction.

Whenever possible animals should be handled with the bare fingers as they are less apt to be crushed than when other methods are employed. When this is impracticable ordinary tweezers with the ends wrapped with soft cloth may be used to advantage; bare tweezers are apt to inflict injury. Small animals may also be handled with a section lifter or a common spoon.

Phototaxis.

1. *Purpose.*—To determine whether animals are positive or negative to white light of a given intensity.

Materials.—Two granite iron bread pans of equal size; black paper.

Procedure.—Put one inch of water in each pan and place in each an equal number of the animals to be tested. Stir the animals until they are equally scattered over the pans. Cover one pan

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with black paper in such a way that no light is admitted and yet the cover can be easily removed to read the position of the animals. Cover the other in the same way except for a narrow slit at one end to admit light and set these pans side by side. Leave undisturbed for perhaps five minutes at the start. Remove the covers first from one then from the other and note the position of the animals. Replace the cover as quickly as possible. Record the position of the animals as follows:

Experiment			Control		
Light third	Middle third	Dark third	Light third	Middle third	Dark third
2	3	5	4	3	3

Repeat as many times as desired. Ten is often a very fair number of trials.

Results.—From the table compiled as above one can determine the response of the animals to the light used by comparing the reaction given by the animals in the experimental pan with those in the control. The common shrimp (Palaemonetes) and the fairy shrimp (Eubranchipus) will collect near the opening in moderate light. Isopods and amphipods will be found in the darker parts of the pan, although they will come nearer the opening if only a narrow slit is left open in faint light.

Discussion.—In order to test the reaction to light of different intensities the width of the slit may be varied, or the pans may be placed in more or less direct light. Care must be taken to have the light enter the pans from as near a vertical position as possible, otherwise the end nearest the light will cast a shadow and the region under the opening will be less strongly illuminated than that some distance away. Artificial light, especially electrical light, may be used to advantage in a darkened room. When this is used it should be placed directly above the open slit and a shallow dish of clear glass containing filtered water (distilled if possible) should be placed between the light and the opening. This acts as a heat screen and avoids complications from a thermotactic response.

This experiment does not give evidence as to whether animals react to light because of the direction of the rays or because of the difference of intensity on different parts of the organism. It simply shows the amount of light in which the given animals will come to rest when most other stimuli are removed.

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2. *Purpose.*—To determine optimum light.[3]

Materials.—Two granite iron bread pans, black paper and different thicknesses of other paper.

Procedure.—Place an equal number of animals in two bread pans. Cover one entirely with black paper. Over the other arrange a graded series of papers having at least four divisions; one with one thickness of tissue paper, the next with one thickness of thin writing paper, the next with heavy writing paper, and the fourth with black paper. Put both pans under a tungsten lamp placed 20 inches directly above the animals. Arrange a heat screen as outlined in Expt. 1. If necessary to obtain definite response add to, or subtract from the different thicknesses of paper. It will be necessary to stir the animals so as to redistribute them just before each rearrangement of the paper. Observe and record results as before.

Results.—The conditions of this experiment give a series of varying light intensities. The light in which the animals come to rest will be the optimum light for them. Isopods and amphipods will collect at the dark end while the common and fairy shrimps will be under the thinner paper.

Discussion.—This experiment may be run in the diffuse light of the room or with any light-giving device that does not cause a shadow to be cast by the sides of the pan. With most animals all the corners of the pan should be rounded out with wax to prevent thigmotactic response. This experiment gives quite definite results when tried with isopods, amphipods, or pond snails (negative to light).

3. *Purpose.*—To determine the reaction to colored light.

Materials.—Two bread pans and three colored glass plates of equal thickness, one red, one green, one blue. Colored tissue paper can be used but the results are less definite.

Procedure.—Using the light described above replace the graded series of paper by the three colored glass plates. Test the reactions of the animals to all possible combinations of the colored plates and find which color is least stimulative. That is, under which color will the majority of the animals come to rest?

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[3]By optimum light is means the light condition under which the activities of the animal are carried on at their most favorable rate. This would therefore be the light condition which would least stimulate the animal under experimentation.

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Results.—Under normal conditions animals that are positive to white light will collect in the blue light. Those positive to fainter white light will be found in the green and blue light. Animals negative to most intensities of white light will collect in the red light and if given time enough will travel from one end to the other as the glasses are moved. Isopods and amphipods will collect in the red, while the common and fairy shrimps will be found in the blue light.

Discussion.—The action of colored light is very complex and much debated. The most plausable view is that positively phototactic animals are positive to the more chemically active blue rays while the same rays repel negatively phototactic animals.

4. *Purpose.*—To demonstrate the reactions of small entomostracans to light.

Materials.—A thin walled, straight sided, glass tumbler and black paper.

Procedure:—Cover the bottom and sides of one tumbler with black paper so as to exclude all light. On one side cut a slit 1/8 inch wide. For this purpose use a sharp knife point. The edges of the slit should be clear cut. Fill with water containing a number of small entomostracans; copepods, ostracods and cladocerans; the more, the better. Adjust a black paper cap so that it can be easily removed. Place the glass with the slit exposed to bright light (direct sunlight is best) for one or two minutes. Without moving the tumbler quickly remove the cap and observe the position of the animals. Arrange another tumbler in exactly the same way except that no light is allowed to enter. How does the position of the control entomostracans compare with those in the experiment?

Results.—In the experiment the entomostracans will be found at the side of the glass nearest the light. They will not be collected in the most intense light but just at its margins. Occasionally one will move out into the direct light. When by chance this happens the rate of movement is increased but the direction is entirely random. The animal may go up or down but, sooner or later, its movements bring it into less intense light, and then the rate of reaction decreases. In the control the animals will be scattered.

Discussion.—This experiment may be varied by arranging a cylinder of black paper as a light screen and leaving the upper end

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open so that the observer can watch the animals throughout the experiment. The experiment shows the light optimum for these animals; that is, they could collect in either brighter or in less bright light, but do collect at the margin of the bright so that this must be their light optimum. Also one will see, from time to time, animals that become reversed in their light reaction. These, swim to the opposite side of the dish and collect in the darker regions.

THIGMOTAXIS.

The tendency of animals to collect in corners is due to a thigmotactic response. Warning has already been given that to test for a light response it is often necessary to round out the corners of the pans with wax. But even with this precaution the thigmotactic reaction cannot be entirely eliminated for the smaller animals generally collect along the lower edges even in darkness. In testing for thigmotaxis, however, it is possible to entirely eliminate the light stimulus and thus more clearcut results are obtainable.

1. *Purpose.*—To test for reaction to touch stimuli.

Materials.—Two bread pans; black paper; thin glass plates or layers of mica.

Procedure.—Fill two bread pans with water to the depth of one inch. Place several pieces of mica or glass plates in one pan as follows: Lay one piece on the bottom and rest one end of another piece upon it. Build the other pieces upon the first in the same manner. Not more than half of the pan should be covered. Put ten to fifteen animals in each pan. Cover tightly or place in diffuse light such that no shadow is cast and let stand an hour or more. Compare the position of the animals in the experiment with those in the control. If the bodies of the animals are touching a large amount of surface, they are positively thigmotactis.

Results.—Isopods give a strong positive response under the conditions of this experiment. That is, they come to rest in the angles formed by the overlapping of the glass or mica plates. Amphipods may be used and will also give positive results. In either case the animals in the control will tend to remain scattered over the entire pan.

Discussion.—When isopods or amphipods are used, this experiment may be varied by exposing the end of the pan containing the pile of glass (or mica) plates to light while the end that is free

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from the plates is shaded. This means that the animals under experimentation must disregard either their optimum light or their optimum touch relations. Usually they will disregard the latter and come to rest in the darkened area thus showing that the phototactic (response) is stronger than the thigmotactic response of these animals.

THERMOTAXIS.

1. *Purpose.*—To demonstrate reaction to a temperature gradient.[4]

Materials.—Four bread pans; two thermometers; a sink with hot and cold water supply.

Procedure.—Place two bread pans on the sink bottom parallel with each other. Allow hot water to flow through one and cold water through the other. Place a third bread pan that contains one-fourth inch of water across the first two so that one end rests in the cold, the other in the hot water. About two inches at each end of the third pan should be exposed to each temperature. Adjust the pans and the flow of water until the hot end of the third pan is about 35 degrees C. Now empty this pan and place in it one-fourth inch of water which has the same temperature as that in which the experimental animals are kept. Put a similar amount of the same water in another pan. Place ten to fifteen of the animals to be tested in each pan. Place one of the second pair of pans across the two already in the sink. Arrange it precisely as the third pan above was arranged. Now place the fourth pan near as a control. It should have the same light relations as the experimental pan but should have the same temperature throughout. As soon as possible after placing the experimental pan in position hold a thermometer at each end and observe the animals continuously. As the temperature rises at the hot end what do the animals do? Compare their position and actions with those of the control animals. Repeat using lower temperature. Repeat using higher temperature but try only a few animals as some are apt to be killed.

Results.—As the water in one end becomes warm the animals will move away. Those that visit that end in their roaming over the entire pan will stay only a short time and will move rapidly

[4] A gradient of any condition is furnished when a series of small changes intervene between two extremes; thus when one end of a pan is at 6 deg. C. and the other at 35 deg. C. with all intermediate stages present, a temperature gradient is established.

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about while there. One or two may die in that end from inability to find cooler water. This experiment gives an example of both negative and positive thermotaxis. The animals are negative to the temperature which they avoid, and positive to that in which they collect.

Discussion.—In case greater extremes of temperature are desired the cold end may be packed in ice on which salt has been sprinkled. When hot and cold tap water are not available, use the same general principle as before but place the lower pans, upon which the experimental pan is to rest, upon ring stands so that sufficient heat (bunsen burner) can be applied to one end to give the desired temperature. Care must be taken to have no shadows in the experimental or control pans as the phototactic response may mask the thermotactic reaction.

This experiment furnishes an easy method of demonstrating the acclimatization of animals to different temperatures. Animals of the same species collected from the same place, brought into the laboratory and kept in different temperatures will collect in decidedly different parts of the temperature gradient.

Any small water animals may be used in this test though those that rest on the bottom, such as isopods, give most definite results.

Rheotaxis.

1. *Purpose.*—To demonstrate response to an intermittent circular current.

Material.—A granite iron or enamel ware pan ten inches in diameter and about two and a half inches deep. The bottom should be covered with beeswax when crawling animals are to be tested.

Procedure.—Place the animals in three-fourths inch of the water in which they have been kept. Arrange the light so that there are no shadows in the pan. Usually it is best to use five animals although this number may be varied with the size and condition of the animals. Leave the animals undisturbed for ten to fifteen minutes in order that they may become accustomed to the new conditions and to permit a recovery from the shock of handling. In case they have been kept in a temperature different from that of the room the pan should be placed in a bath that will keep the temperature within one degree of that to which they have been accustomed.

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After fifteen minutes start a current by stirring slowly with the wrapped tweezers used in handling the animals. In order to secure an even current run the tweezers five times around the pan, near the edge and at a uniform rate. Gently stir all the animals loose from the bottom. Take time for one minute after the stirring stops and record the reaction of each animal. If an animal goes against the current for forty seconds and with it for the remainder of the minute it would be counted positive, while if it goes with the current half the time and against it for the other half it should be classed as indefinite. Trials should be continued in this fashion until ten consecutive tests have been made. From the results recorded the percentage of animals going positive, negative, and indefinite to the current may be calculated, and the animals rated accordingly.

Results and discussions.—The results with isopods will depend upon the habitat from which they were taken and on the time of year. Pond isopods will give a low positive response while those from streams will give a much higher percentage of positive reactions, except during the breeding season when this may be lowered. Amphipods show the same characteristics. Both the fairy shrimp and the common shrimp will usually go against the current.

Minnows from one to three inches long are the best material with which to demonstrate positive rheotaxis for class room purposes. Almost any of the common minnows will swim vigorously against the current reversing directly as the current is reversed.

GEOTAXIS.

Purpose.—To test for gravity acting as a stimulus.

Materials.—Two glass cylinders, the larger the better; 500 cc. graduated cylinders will do; string or wire gauze; sand and black paper.

Procedure.—Place a half inch of sand on the bottom of each cylinder and fill with water. Arrange several strings so that they hang from top to bottom, or roll a wire gauze cylinder and place this with one end resting in the sand. Cover each cylinder with black paper. Introduce into each from five to ten of the animals to be tested and allow to stand fifteen minutes. Record the position of the animals in inches from the bottom. Repeat the observation at least five times.

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Results.—Isopods and amphipods will collect at the bottom, that is they are positive to the stimuli acting. Eubranchipus will be at the top, hence, they give a negative reaction.

Discussion.—This experiment as it stands is simply a double experiment without a control. It may be varied by admitting light at the top of one cylinder and leaving the other covered. If this is done the fairy shrimps (Eubranchipus) will leave the top and collect at the bottom of the cylinder, because they are said to be positive to gravity when light is acting. Another variation is to illuminate strongly the bottom inch of one cylinder while the other is left dark as a control. Under these conditions isopods and amphipods will move up out of the light thus disregarding their reaction to gravity in order to react light.

Any small water animal may be tested in this device.

In a darkened cylinder such as was first described, it must not be thought that gravity is the only stimulus acting. For one thing the deeper the water, the greater the amount of pressure, so that there is a water pressure gradient which is lowest at the surface and increases rapidly with increasing depth. Then, too, the gaseous content of the water is different at different depths. As an instance, in a ditch near Hammond, Indiana, with the water about one foot deep and the bottom covered with leaves to a depth of nine inches the following differences were found:

Position of collection.	Oxygen in cc. per liter	Carbon dioxide in cc. per liter.
Surface	3.87	13.5
Mid depth	2.79	6.0
Top of leaves	2.79	6.0
Top of leaves	2.79	6.0
Middle of leaves	2.49	8.5
Bottom of leaves	1.95	9.0

In open lakes greater differences are shown, thus:

Position of collection.	Oxygen in cc. per liter.
Surface	4.6
20 in. below surface	13.8
40 in. below surface	9.8

Small fishes will react negatively to the difference of carbon dioxide shown above, while both fish and isopods will react to the oxygen gradient given in the lake. Obviously then animals may react to a gas gradient in the conditions described for the experiment on gravity and they are always subjected to differences in water pressure under the given conditions. Thus it is apparent that what has been usually classed as a response to gravity may have a much more complex cause.

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General Notes

These experiments can easily be modified to suit local conditions. They cannot fail to give results because animals subjected to a given set of conditions must respond in some way, providing they are in good condition. If they do not move it means either that they will not respond to that stimulus at all or that the stimulus acting is not strong enough. This last possibility can be tested by increasing the stimulus. Even if it is found that animals give no response that is as important a fact, though not quite as interesting, as if they responded.

Always in experiments in animal behavior the relation between the experimental response and the reactions in nature must be borne in mind in order to make the experiment of any practical value. Thus isopods live among decaying vegetation on the bottom of ponds and streams. They come nearer the surface at night and on cloudy days than at noon on bright days. In the laboratory it is found that they are negative to strong, though positive to weak light and this gives the explanation for the daily migration. It is also found that they are positively geotactic and this accounts in part for the fact that they are normally found nearer the bottom than the surface. In another experiment one finds that they are positive to touch stimuli and this together with the fact that they are negative to light explains their presence among decaying vegetation. Another factor that would bring them among the decaying vegetation from time to time is that here they find their food and find it perhaps by a more or less decided chemotactic response. When the fact is added that isopods in ponds where currents are absent are less positive to water currents than are those in streams where the currents might carry them down stream; also that their thermotactic reaction tends to keep them in uniform temperature, there is assembled the complete explanation of the reactions of isopods under experimental conditions and the relations which these reactions bear to their normal responses in nature.

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Some Criticisms of the Present Method in School Gardens*

VERNON LANTIS.
(Instructor in School Gardening, Cincinnati, Ohio.)

The School Garden Movement, though but recently introduced into America, is making its presence felt because of what it is accomplishing. In spite of what the movement is accomplishing, however, and with the view to making it of still greater service, I wish to offer a few criticisms on the School Gardens as they exist today.

The first criticism which I wish to make of the School Garden movement is that only a few children are reached by the movement. If the Garden work has a beneficial influence upon the average child, as we know it has, it is not too much to say that every child should have a chance to share the advantages of the Garden.

During the past summer, I visited the School Gardens in Cleveland, New York, Yonkers and Philadelphia. In the Fairview Garden School at Yonkers, New York, there were enrolled about six hundred children. Mr. Mahoney, superintendent of the Gardens, told me that three hundred more, nine hundred in all, had applied for garden plots, but more than six hundred could not be accommodated. According to Mr. Mahoney, the garden is accessible to, and draws children from, about one-sixth of Yonkers. The population of this portion of Yonkers is fourteen thousand (14000). I did not see all the School Gardens in New York City, but from what I saw and heard, I feel safe in saying that not more than five thousand children have the advantages of the School Gardens. The population of New York City is 4,800,000. It is only a little problem in percentage to find, that of all the children in New York City, who, if they knew of the Garden, would be clamoring for a place in them, only 1.6 per cent really have access to the same. The same condition is probably true for practically every city in the country. Anyone can readily see, from the facts in hand, that, where one child has the privilege of the School Gardens, there are fifty children and perhaps many more who can not have access to them. The Home Garden, which originated in Cleveland, offers a remedy for this.

*Portion of paper read before a meeting of the School Garden Association of America at Cleveland, Dec. 31, 1912.

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In Cincinnati, the inspectors visit the School Home Gardens, offer criticisms and suggestions on the work, and encourage the children, wherever criticism, suggestion or encouragement is needed. The principles underlying the operations, demonstrations of the same, and some practical work should of course be given the child at school, so that only occasional visits of the inspectors are necessary.

A second criticism of the School Garden Movement is that the movement is not bringing about one of the chief objects for which it was said to have been instituted or at least it is but slowly accomplishing this purpose. I have reference, of course, to the beautifying of our cities. In spite of the fact that the garden plots are kept clean and attractive, the lawns and back yards at the homes of the children, are on the whole improving very slowly, if at all.

Judging from the School Gardens which I saw this last summer the child is permitted to grow in his plot, lettuce, beans, beets, tomatoes, carrots and a few other vegetables. It is perhaps not a mere coincidence that carrots were found in all the gardens in great abundance. In only two of all these gardens, did the child grow flowers on his plot. It is certainly a far cry from raising a patch of carrots to making and maintaining beautiful surroundings.

Of course I understand that if the child keeps a six by ten plot of ground attractive now, he may, in years to come, keep his place of residence attractive. But if the child, besides taking care of a small plot of vegetables, should grow fine sod on the lawn, grow paeonies and irises, privet, snowballs, spireas, lilacs, roses, and the like, from seeds or cuttings, and adorn the lawn and backyard of his home with these, would he be less likely to keep his place of residence attractive when a grown-up? Is it not obvious that he would be much more likely to do so?

In Cincinnati, while the child will not be discouraged in growing a patch of carrots, he will be encouraged to make his place of residence beautiful by growing many of the pretty annuals and perennials, both herbaceous and woody, which adorn and beautify the fine lawns in the wealthy suburbs.

The third and last criticism, which I wish to make of the School Gardens as they exist at present, is, that the interest created in the child is not permanent. Educators tell us that

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among other things education should create in the boy or girl several wholesome and permanent interests—thus affording them pleasant occupation for their leisure moments. The big cities afford only too many mediocre attraction for the child, as well as the man of leisure, and if the children do not have some wholesome interests to indulge in for entertainment and pasttime, some will be found going in the direction of these attractions.

I believe, the creation in the child of a permanent interest in plant culture, is one of the most important functions of the School Garden Movement. Once we create, in the children, this permanent interest in plant culture, we have done much toward giving them pleasant occupation for their leisure moments and we have solved, once for all, the problem of beautifying our cities. I do not mean to say that every child will want to make gardening or some phase of gardening his hobby, but I firmly believe that, if only the work is properly administered, all will find in plant culture a permanent interest,—one that is most absorbing and extremely fascinating.

Judge Caldwell of the juvenile court of Cincinnati, says, that whereas, before establishment of playgrounds, three or four juvenile delinquents were sent to him, each week, from certain districts, now, since the establishment of playgrounds, none are sent from these districts. I am told by many, in charge of school gardens near playgrounds, that children will leave the playgrounds to work in the gardens. This in itself is proof that the garden work is most alluring and fascinating to the child.

But why should not this interest be permanent? In all the visits made this past summer I nowhere recall seeing boys or girls above the age of fourteen years working in the garden. At places I was told it was not wise to take into the garden children above 14 or 15 years of age, since they would be but little interested in the work. I think I can see a reason for this lack of interest among older boys and girls. In the school gardens, where these conditions exist, the plots assigned to each were of a certain given size and shape, with a certain fixed number of rows, each containing a certain fixed number of plants. A certain vegetable, and no other, must be in the first row. And the same is true of all the other rows. Can we wonder that the children tire of this after a couple of years?

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Do not misunderstand me, I appreciate the good work done in these gardens. It is excellent as far as it goes, but it does not go far enough. From the very nature of a school garden, it is not possible to allow the children much freedom. In other words there must be something to supplement the School Garden if Plant Culture is to be a permanent interest with many of the children. Again, the Home Garden helps us to solve the difficulty.

In our School-Home Gardens in Cincinnati, the child will be encouraged to grow a patch of vegetables, but by no means will this be all. He will also be advised to grow some of the pretty annuals as alyssum, phlox, verbenas, scabiosa, scarlet sage, snap dragon, and a whole host of others. He will also be advised to grow many of our pretty hardies, as chrysanthemums, irises, paeonies and others, also dahlias, cannas, and other tuberous rooted plants. Of course these will be grown from seeds, not alone because of the cost, but because of the pleasure obtained, the interest aroused and the training acquired from the work. Again he will be encouraged to grow, from seeds or cuttings, certain of the shrubs as spireas, lilacs, snowballs, golden bells, roses, California Privet, and others. Also certain of our hardy climbers as ivy, clematis, honeysuckle, wistaria, and others. He will also be advised to grow trees, from seeds, as oak, walnut, catalpa, sweet gum, linden and others. Of course the inspectors will advise the child as to which plants are adapted to the conditions, to which the plants will be subjected, and likewise will advise him not to try those which for some reason are not suited to the place. Under the direction of the trained inspector the child will be encouraged to attempt the propagation of plants new to him, and yet plants which are useful in adorning the lawn, or useful for some other purpose. Nor will the child be discouraged in trying an experiment just to satisfy his curiosity as long as the experiment does not seriously affect the other garden operations.

Most certainly the little child will not be encouraged to try all this the first year. For his first year in the garden, he will be encouraged to grow radishes, beets, beans, and or course carrots, together with such flowers, as four-o-clocks, nasturtiums and lady slippers. The second year, besides the above, others may be added which involve the operation of transplanting. Another year, some of the easier grown plants may be omitted from the list and others added. By the age of 12–14, the child should

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be given great freedom in the choice of plants raised. If this is done, I believe he will not altogether lose interest in and discontinue the work. You recognize this plan of course as the Hartford plan. I believe it ideal.

The purposes, of the above program, let me say again, are twofold, first and by far the most important, is the creation in the child of a permanent interest in plant culture. Second, and of no small consequence, the beautifying of our cities. I firmly believe that both ends will be attained if this program is carried out.

Last Spring one of the inspectors told her boys why we budded, how it was done and demonstrated the operation. Two of her boys successfully budded roses. The boys and the inspector were greatly elated over their success. Who is there that believes either of the boys will ever forget this experiment? I believe that just such experiences, as these, will cause boys to become permanently interested in at least certain phases of plant culture.

Some condemn such practices as budding and grafting and label them as unfit to have any place in the school garden movement. They call it poor school gardening if any time is devoted to such practices. If it is poor school gardening, to create, in the child, a permanent interest in plant culture by any means other than raising carrots, then I hope the entire country will speedily be inflicted with poor school gardening.

As I have said before there are those who insist that the plots in the school garden must be four by eight, and only lettuce, radishes, onions, beets, corn, beans and carrots grown in the plot and these in the order named. Excellent work is done in the gardens where this plan is followed. And yet I fear the child becomes at first deeply interested in gardening only to become thoroughly disgusted a little later because he must repeat the same process year after year, and is not given a chance to show his individuality. I understand that there are many secrets hidden in each plant and that it is well to make an intensive study of a few plants. But is it certainly all wrong and a great injustice to the children concerned to insist that all be content with doing research work on carrots.

Other criticisms of the School Garden Movement might be offered but the writer feels confident that when the above criticisms are met the movement will have a still wider and greater influence than it does at present.

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The Spring of 1913

MARY F. BARRETT.

One criterion of the earliness or lateness of a season is the time of first flowering of its plants. An accurate determination of this would involve a comparison in successive years of the dates of blooming of a number of plants, the individual specimens examined and the conditions under which they grew being always the same.

A rough estimate, however, may be obtained from a school flower calendar on which plants from a more or less limited area are reported. The following results are summarized from the spring calendar kept for the last five years by the students of the State Normal School at Upper Montclair, New Jersey. From the wild and cultivated flowers reported during that time fifty were selected which answered to the following conditions: they were located within a radius of thirty miles with Montclair as a center, they blossomed before June 1st, and they were reported each year of the five, the reports being accompanied in most cases by specimens of the blooms. A table was then made using the year of 1909 as a basis and calculating for each flower in each the number of days by which its bloom preceded or followed that of 1909. The results are as follows:

1910 was 7.7 days earlier than 1909,
1911 was 3 days later than 1909,
1912 was 4.6 days later than 1909,
1913 was 11.2 days earlier than 1909.

The spring of 1913, then, appears to have been about two weeks earlier than those of 1912 and 1911, about three days earlier than 1910 and eleven days earlier than 1909.

Editorial

The summer is passed and with it that period of recreation when the average American devotes himself with some degree of zest to rest and recuperation. The city, especially, turns with pleasurable anticipation to the haunts of nature. Business centers are more or less deserted, as people of means seek shore or mountains, and even the dwellers in the poorer districts spend pleasurable days in nearby picnic groves and parks. So all of

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us confess our instinctive desires to get in touch with nature, that kind renewer of youthful ardors. A few of us will keep up the joy of this rejuvenating companionship. We shall go out to walk, collecting, picture-taking, or just tramping regardless of season and weather. We shall consciously cultivate that healing, inspirating comradeship with the out-of-doors. "Our hearts will beat and our eyes will be bright as we leave the town behind us and we shall feel once again (as we have felt so often before) that we are cutting ourselves loose forever from our whole past life, with all its sins, and follies and circumspections and go forward as a new creature into a new world." Time may seam the faces of such with lines of care, but youth will rise perpetually in their hearts.

A few of us will lead little children into these paths of delight, will teach them to appreciate the commonplace things about them, to look with understanding eyes and hear with comprehending ears. We shall stimulate our pupils by imparting our own contagious enthusiasm. Blessings on that teacher who can put so simple yet so far-reaching a source of delight, so sure a basis of sturdy character, into a child's life.

That teachers are seeking preparation for instruction along the lines of Nature-Study is evident from our increasing summer school attendance. Five hundred sixty-nine summer schools were open in the summer of 1912. The figures for 1913 are not yet in. There were 142,217 students in attendance at these schools—about one-fourth of the entire teaching force. One hundred thirteen of these schools were schools devoted to business, medicine, and other subjects in which one would not expect courses in any phase of nature-study. In the remaining schools everyone gives some science instruction: 91 specifically announce courses in agriculture, 36 in nature-study. Evidently teachers, the country over are awake to the educative values of the things of the out-of-doors. They are surely trying to find out what to teach along these lines and how to teach it.

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Book Reviews

The Bird and Nature Study Manual, by Harold B. Shinn and Girard A. Abbott, 459 pages, John C. Mountjoy, Publisher, Chicago. $1.50.

After a brief introduction of the method of presenting nature-study there are some general chapters: Homes of Animals, The Relation Between the Animals' Feet and Their Habits, Between Teeth, Diet, and Disposition, On the Color of Animals, Mother Love and Babyhood, Parasitic and Social Habits, The Relations Between Plants and Animals, Insects and Pollination, a brief chapter on Beneficial and Injurious Insects, and a chapter on Books of Reference. There then follow 272 pages on the birds, mostly devoted to descriptions of the common species and to their habits. Three pages on minerals and gems follow, then some 30 pages on Plants, Medicinal and Commercial, 7 pages on shells, 10 pages on insects, and the rest of the book on the Vertebrates. These pages on the Vertebrates are largely descriptive, and there are included descriptions of the Kangaroo, the Armadillo, the Hyrax, etc. One wonders why these are included in a manual for North America Bird and Nature-Study. Evidently the book is intended for use in special courses and would be of little value to the average teacher. The descriptions of birds that make up the bulk of the book could be equally well found in any good bird manual. The nature material is not well balanced for ordinary use, nor is the treatment judicious. There are included lists of questions that are to be answered by the pupil. Many of them, however, pertain to animals that the pupil could be expected to see, such for instance as the beaver, the otter, the whale, only if extensive zoological museums were available for the study.

In Beaver World, by Enos A. Mills, pages xiii+ 228. Houghton Mifflin & Co., Boston, $1.75.

No one has had better opportunities, in recent years at least, for the study of the beaver than Mr. Mills whose residence in the Rocky Mountains has been a long one full of delight in the study of animals of that region. The book gives the reader a very vivid notion of the life and industry of the beaver. There is no animal whose work is so extensive, so permanent and skillful as is the beaver's. The animal, therefore, is an excellent one for the study of

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the problem of animal intelligence. Mr. Mills believes that the beaver is an animal with a good deal of intelligence and cites his skill in building the dams, dredging the canals, and dealing with the general engineering problems, as conclusive evidence of his very intelligent work. Possibly some of his evidence is open to criticism. For instance he cites the case of an aged beaver who "waddled near an aspen, gazed into its top for a few seconds, then moved away and started to fell a five inch aspen. The tree which he refused to begin work on," he tells us, "was entangled at the top so that it would not have fallen even if the beaver had cut through the trunk." On page eight, however, in discussing the senses of the beaver he says "The eyes are weak." One wonders if an animal with poor sight would see the entangled branches. In another case he cites an instance of a young beaver undertaking to cut down a tree upon which another beaver had been working. Instead of taking advantage of the cut already made he began work some four inches below the cut and finished the job without utilizing the work already done. It would seem difficult, however, to explain many of the actions that Mr. Mills describes, especially the construction of canals, without granting to the beaver a very high degree of animal intelligence.

The Mechanistic Conception of Life, Biological Essays by Jacques Loeb, 232 pages. The University of Chicago Press, $1.50.

Dr. Loeb has for many years been known as one of the foremost champions of the idea that life phenomena are reducible to chemical and mechanical explanations; in his words, "that the sum of all life phenomena can be unequivocally explained in physical and chemical terms." This book is an attempt to indicate the progress that we have made in such an explanation. He himself was the first investigator to demonstrate the possibility of starting up the development of the egg by chemical stimuli instead of the customary introduction of the sperm, and quite a little of the book is devoted to a description of the methods used to accomplish this and to the inferences from such work. He has also done a good deal of work on the reactions of animals to such stimuli as light, heat, and electric currents, and he points out how many of the life phenomena are to be explained as reactions to these stimuli, not only showing that there are such reactions, but explaining in very plausible ways the manner in which these forces act upon the

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physical and chemical elements of the animal to produce the results. He points out the significance of such reactions as the basis for the psychology of the animal. In all there are ten of these essays. They are exceedingly interesting and stimulating. Dr. Loeb's style is simple so that the methods of procedure, the results and the conclusions, are perfectly clear even to one who has not had biological training. He makes apparent that many of the so-called vital processes are explicable on a physical and chemical basis. Judgments will differ as to how far it is safe to conclude from such evidence that all vital phenomena are to be so explained.

Seeing Nature First, by Clarence M. Weed, 309 pages; J. B. Lippincott Co., $1.50.

This book has almost the charm of the writings of William Hamilton Gibson. Mr. Weed has facility of expression, a keen sight, and the artistic sense that made Gibson's books take first rank as nature-studies. The title of the book indicates its purpose—to lead one to seeing the things about him. We are getting such a deluge of nature books, especially nature readers, that the nature enthusiast is afraid constantly people will read about nature rather than study nature herself. This book, however, makes you really want to get out-of-doors and see some of the things that Weed has seen and described so enticingly. The book is seasonal, divided into spring, summer, autumn, and winter, with most of the space devoted to summer.

The illustrations are partly photographic, partly pen and ink sketches. The frontispiece is in color. The descriptions include both animals and plants, the animal material predominating.

Household Bacteriology for Students in Domestic Science. Estelle D. Buchanan and Robert Earle Buchanan. Pages, 536; figures, 360. Published by the MacMillan Publishing Company, 1913. $2.25.

This book is an evidence of the tendency now to be noticed amongst all of the sciences towards rearranging the materials of science in terms of education through subjects that are vocational, industrial, agricultural and related to the home. Much of the material found in the book is identical with that already published in books upon bacteriology, botany and hygiene. The new

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arrangement, however, gives it a purposeful organization which will make the material immensely more valuable to students of domestic science. The fundamental scientific aspects of the bacteria and of the chemical and physical processes associated with them are adequately presented, with the possible exception of the restricted discussion of the relation of bacteria to decay. Twelve chapters given to the relation of bacteria to different diseases include an excellent summary of the present state of our knowledge of human diseases, and additional chapters summarize our knowledge of the distribution of disease germs through water, milk and other foods. An appendix which includes 40 illustrations of different types of molds will make it possible for students to identify most of the common fungi that they will encounter in connection with bacteriological work.

The book will serve excellently as a textbook in bacteriology for general elementary courses in agricultural schools and schools of domestic science. It is to be hoped that other branches of science not now represented by such purposeful presentations of their subject matter may rapidly be so organized.

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THE NATURE-STUDY REVIEW

DEVOTED PRIMARILY TO ALL SCIENTIFIC STUDIES OF NATURE IN ELEMENTARY SCHOOLS

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The Leaf-Portfolio as an Aid in Tree-Study

ANNA BOTSFORD COMSTOCK

With illustrations engraved from leaf prints made by the pupils of Professor W. W. Gillette, of the St. Andrew's School, Richmond, Virginia.

The value of making a collection is three-fold: it serves to teach the collector about the objects collected, which satisfies the desire, especially of the child's mind for bringing objects together and classifying and arranging them, and the collection remains as a reference to refresh the memory; and, moreover, it may also be beautiful as well as interesting.

Because of these reasons a portfolio of the leaves of the trees of a region proves a great help in tree study, which may thus be begun earlier than if started in a more fundamental manner. Since it is necessary to know the names of things in order to pursue their acquaintance profitably, the making of a collection of leaves is a ready way to learn the tree names, and it also introduces the pupils to the tree manuals.

There are several ways of making these leaf portfolios, but there are two essentials in making them by any method. These are, accuracy in determining the trees so as to label the leaves properly, and the making the collection as complete as possible. The most natural and perhaps the easiest way of making the portfolio is to gather the leaves, press them, mount them on uniform sheets of paper, and label them. If this work is begun in the autumn, which is the best season of all for beginning tree study, there is the added interest of the glowing color of the foliage; and if there is a desire to preserve the autumn colors the leaves may be waxed and ironed instead of pressed. This is done by passing a moderately hot

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flat-iron across paper upon which has been scattered bits of wax, and then passing the iron carefully over the leaf, first on one side and then the other. Leaves thus pressed should be mounted by gumming them to the paper. The mucilage should not cover the entire lower surface of the leaf, but should be put on in dabs here and there, just enough to make the leaf adhere.

American Linden

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Another and more elaborate portfolio is made by water color drawings of the leaves and fruits. This is a rather extensive undertaking and usually results in an unfinished portfolio. A less difficult method and more easily accomplished is to simply trace or draw the leaves with a pencil or pen; and this is quite as valuable pedagogically as the more elaborate drawings.

Still another method is that of making blue prints of leaves; this is a favorite with young photographers. The blue print paper is cheap, the prints are easily made and are clear and satisfactory. These prints should be carefully trimmed and mounted on uniform sheets of paper.

River Birch

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But perhaps the most satisfactory way of all is making a portfolio of leaf prints. The tools needed are a large, smooth, slate or better still, a thick plate of glass, measuring about twelve to fifteen inches and costing fifteen or twenty cents; a tube or jar of printer's ink, either green or black in color and costing fifty cents, the one tube containing a sufficient supply of ink for the making of several hundred prints; and two six-inch rubber rollers such as photographers use in mounting prints, these costing fifteen cents each. A small bottle of kerosene should also be included in the outfit, as a few drops may be needed to dilute the ink in case it should be a little too thick to spread freely over the slate and roller. The paper used in making the prints should be of good quality, with a smooth surface in order that it may take and hold a fine, clear outline.

Silver Maple

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To make a print, squeeze a few drops of ink from the tube upon the glass or slate and spread it about with the roller until there is an even coat of ink upon the roller and a smooth patch in the center of the glass or slate. It should never be so liquid as to "run," for then the outline will be blurred. Ink the leaf by placing it on the inky surface of the glass and passing the inky roller over it once or twice until the veins show that they are smoothly filled with ink. Now place the inked leaf between two sheets of paper and roll it *once* only, with the clean roller, bearing on with all the strength possible. We find that a second passage of the roller usually ruins the print by slightly blurring or doubling every line in the leaf, particularly if the mid-rib and veins are at all prominent. Two prints of each are made at each rolling, and sometimes one side will give an excellent print while the other may not be very clear, but usually the impressions of the two sides seem almost identical. Dry and wrinkled leaves may be made pliant by soaking in water, dried between blotting paper; then proceed the same as for fresh ones.

Prints may also be made, a number at a time, by pressing under weights, being careful to put the sheets between the pages of old magazines or to place cardboard or folded newspapers between the pairs of the sheets having leaves between them, in order that the impression of one set of leaves may not mar the others. If a letter-press is available for this purpose it does the work very quickly. Prepare the sheets as directed, place in the press, screw down tightly for a moment and then remove.

For cleaning the outfit after using, a bottle of benzine should be kept on hand, carefully stored in a place where there is no fire. This will not only remove the printer's ink from the glass and roller, but will cleanse the fingers of any stray smears that may have been obtained by accident.

The portfolio is made of common green holland such as is sold for window shades. Its border is the passe-partout ribbon sold for framing small pictures and used by photographers for protecting lantern slides. Its end-flaps are secured by an elastic band one-quarter inch wide, passed through the two eyelets at one end and sewed fast. At the opposite end the eyelet is strengthened by a circlet of strong paper or thin cardboard and a common dress hook on the end of elastic bands hooks into these strengthened eyelets and holds the flaps in place. The two bands at the sides are

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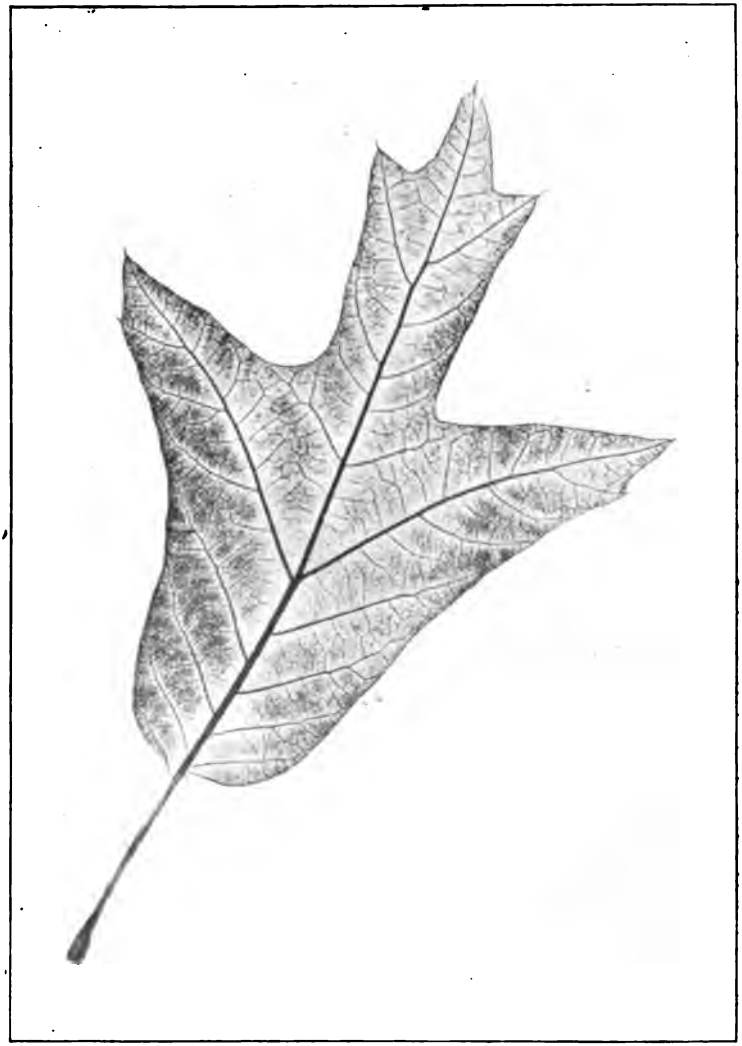

Spanish Oak

strengthened with the holland carefully pasted on, for they thus not only strengthen the portfolio but give it a square, box-like shape, instead of uncertain edges.

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Field Work Records

JAMES G. NEEDHAM

When a class goes out to do field work what kind of a report of the work shall be required at the hands of the student? I take it that no teacher will question the need of record-making, if the trip afield is to be for more than an airing. I take it all will agree that a good field work program will require from the student results just as definite as those of a laboratory-work program. For such a record serves the same ends. It facilitates the accumulation and comparison of data. It concentrates attention on specific points and gives purpose to observation and insures results. Teacher and pupil alike need to have something to show for the experience gained.

Field work is not merely laboratory work done out-of-doors—at least, it should not be this, if its chief values are to be realized. Field work especially facilitates seeing things in the large. Its program should be different; its emphasis is different; its tools are different. An axe is a much better field-work tool than is a scalpel. Field work should give an appetite for the smaller details that are properly sought in the laboratory. For working out details the laboratory has certain great and perfectly obvious advantages. It has a roof and a floor and heating and ventilation systems which provide uniform working conditions and eliminate the vicissitudes of the weather. It has walls that shut out distractions. It has chairs and tables for the convenient bestowal of ourselves, our apparatus, and our specimens. It brings light and water and liquid fuels, and sometimes even specimens to us. What wonder if with all these advantages it should be-times seem sufficient unto itself. Certainly, laboratory work should be done in the laboratory. To attempt to do it out-of-doors is a great waste of time, as well as a failure to grasp another sort of opportunity.

The other is the opportunity for learning the qualities of things in nature; their fitness as measured by the standards of the competition of life; what things are good for, and how they get on in the world. This is fundamental education. The boy who roams the woods and does the mixed chores of the farm, must get some of it. He may lack discrimination; he will overlook most interesting and important details; but he learns of necessity the qualities of things that make them factors in the struggle for a place in the

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world. Right here lies the educational advantage which the country boy has had in past generations. He has started with his feet on the ground.

Such experience is of the field, rather than of the laboratory. The city boy may have it by going after it. Vast areas in which to roam are, fortunately, not necessary. Indeed the country boy's experience might be bettered if his method of acquiring it were less desultory, less wasteful of his time: if instead of being left wholly to his own devices he might have some help and guidance toward making his random observations more connected and comparative.

Such are the limitations on our time when we do field work with classes that we are forced to the opposite extreme of prescribing definitely the work to be done and the records that shall be returned in evidence of it. In the preceding article of this series, I have made mention of certain optional studies which I shall use as vehicles for spontaneity and originality of observation, even with large classes. In this one I wish to speak of the kinds of records required to be made when the work is done in classes.

I find myself requiring four different sorts of field-work records according to the nature of the work involved. These are (1) drawings, (2) maps, (3) tables and (4) lists. These four are doubtless familiar enough to every teacher, but there are probably many teachers who have not fully considered their varying utilities. I will discuss these briefly, beginning with the one most commonly used.

Drawings, and structural diagrams.—Drawings have the great merit of forming, when well done, the most explicit possible record of things seen. This is one reason why they are so much used in the laboratory; but another reason is because they are easily examined and criticized by an instructor. Furthermore, the student, consulting his old records, finds that drawings bring vividly to mind again the subject matter of studies past. Their limitations lie in the time consumed in making good drawings, in the danger that time-serving tasks will be set because so easily planned and assigned, and in the unequal distribution of talent for graphic representation among the members of a class. Poor drawings that do not show anything make the most abominable of records. Far too much laboratory drawing is now required—especially too much of the sort that is mere repetition of details.

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Drawings and diagrams are, and will continue to be, the principal feature of laboratory records; but they are much less available in field work, for the obvious reason that in the field the conditions for making good drawings are lacking. A notebook carried about in one's hand may have a few graphic lines entered in it but hardly a detailed and finished drawing. Sketches and diagrams of things that can be rendered in a few simple lines are the practical limit. To attempt more than this out-of-doors is to waste valuable time, for which there is better use. I have found my laboratory trained helpers, one and all, inclined to grade field work drawings far too much on their finish and far too little on their data-content. The laboratory standard of details and finish is not applicable to field work.

2. *Maps and place—diagrams.*—These provide for graphic records of a sort most useful in the field, where the spatial relations of things in nature are to be set forth. They are quickly made, they are easily read. They graphically recall the facts to memory; they demand no special artistic ability. Blank maps need to be supplied when a large area, such as a field or a stream, is studied: for a small area or one with simple outlines, the student may make his own map and then add the details.

The limitations to the use of this sort of graphic record lie in that but few things can be shown on a sheet without confusion: it is applicable to showing broad relations—not abundant details.

3. *Tables.*—When close comparison of numerous characters of a few classes is desirable there is no device more useful than a table, provided with column headings covering the points to be observed and compared. In my course in the Natural History of the Farm, I have used such a table for getting acquainted with the characters of the local edible fruits: also, for other similar studies. The fruits available in autumn are wild crabapple, hawthorns (several species), wild grapes, choke cherry, bird cherry, mountain ash, nannyberry (*Viburnum lentago*), spice-bush berry, poke berry, wild gooseberry, hackberry, cranberry, partridge berry, wintergreen berry and several others. The column headings used have been:

Kind of plant (herb, shrub or tree).
Type of fruit (pome, drupe, berry, etc.).
Cluster (diagram).
Size (dimensions in mm.).
Number of seeds.

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Proportion of edible pulp.
Used for what.
Competitors for it.
Inhabitants of it.
Remarks.

The last column provides for stating characters of a miscellaneous sort, not covered by the other headings, and is always needed.

In such a table, likenesses and differences appear very distinctly. It is chiefly valuable as a means of facilitating comparisons. Its limitations at once appear when the things compared are so diverse that their characters do not admit of contrast and will not conform to any set of column headings. Furthermore, examination of such a table when completed is slow work. Small diagrams may often be used instead of writing in certain columns, making characters both plain and easy to read. I have found that twelve to fifteen new fruits, etc., are about all my classes are able to acquaint themselves with in one field trip.

Annotated lists.—This is the sort of record that admits of treatment of the largest number of objects in the remotest variety of ways. When tables are inadequate for want of space or of flexibility, then the annotated list comes in. It is useful because it admits:

1. Any number of things for consideration.
2. Any extent or form of presentation.
3. Variable treatment according to relative importance.
4. Any arrangement of sub-groups.
5. Personal initiative in choice of material and methods of record-making.

Its limitations lie in the indefiniteness of the work assigned, which, with some students leads to scant returns, and with others, leads to an excess of writing, to be followed by endless reading of notes when the records have to be examined. These difficulties may be in part ameliorated by giving out examples of the kind of notes desired, by stating the kinds of facts to be sought, and by recommending conciseness, and the use of simple diagrams to illustrate the lists.

Now, having listed these four forms of records separately, let me hasten to say that I rarely use one of them alone. I like to have my annotated lists illustrated. I combine lists and maps and tables freely. I prefer tables filled with diagrams wherever possi-

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ble. I like to have my pupils see things, and then choose their own way of making a report upon them, whenever they show sufficient insight; they add photographs sometimes, and sun prints, and specimens if they choose, or even write essays with my approval and consent. Anything but time-serving is acceptable to me.

School Gardens in Idaho

MAMIE LEE POLLARD

At Lewiston State Normal (one of the two normal schools of Idaho), Nature-Study is a department of itself. This fact greatly simplifies the garden work which is a part of Nature-Study in all grades of the training school above first grade, for instead of as many units and plans as there are grades, one system unifies the several components into a central scheme.

Throughout the course the aim for children is to learn to plant and care for a vegetable garden sufficient to supply a family. Almost as important is the method employed. This means that tools are to be kept clean when not in use; tools are to be returned to their places and precision and accuracy are exacted in measuring and planting. These ideals are not difficult to realize if the teacher is vigilant and prompt to drill, train, remind and reiterate.

For grades two and three the definite aims are (1) to educate children to use garden tools properly; (2) to keep a garden weedless and well cultivated; (3) to identify readily the seeds and plants of four or five common vegetables. Identification of such common weeds as Russian thistle, pigweed and wild mustard is required also. These grades each have their class gardens.

Beginning with grade four individual gardens are the rule but this year a lack of previous consecutive garden work among fourth graders made it seem best to drill them one more year in class gardens. Assuming, however, the conditions that are permanent with this exception, grades four, five, six, seven and eight, have individual gardens. Each child is assigned a plot but is given a choice of vegetables from a list of twelve. No child is permitted to plant more than three kinds of vegetables; two are frequently chosen.

The aim in grades four, five, and six is economic. Children learn by means of their gardens the value of manual dexterity and

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the great money saving effected by owning a garden. With market prices as a basis, each child subtracts from the value of the mature vegetables grown in his plot, the cost of seeds and, since the land is rent-free regards the difference as the value of his efforts. Of course seeds are free for use in school gardens but the estimate is made for the purpose of so awakening and interesting children as to stimulate them to become home gardeners, in which case the cost of seeds is an expense item. This spring the second grade in one day harvested 395 radishes; third grade, 217; fourth grade, 196;

Second Grade Harvesting Radishes

seventh and eighth together, 227. The total of over a thousand radishes were worth about four dollars and in no grade was one-half the crop brought in.

As our school plots are not large, there is much rivalry among pupils to obtain best results from intensive cultivation. Exactness and accuracy are details of the discipline side of garden benefits that are emphasized.

In grades seven and eight* the utilitarian and disciplinary aims are not lost but give precedence to some elementary study of plant processes and to slightly technical training in agriculture and botany. Otherwise stated, the aim here is to know scientifically

*Pupils in grades seven and eight registered for gardening were so few as to make it wise to combine both grades into one class.

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the reasons for various processes. The effect and value of soil cultivation, the effect of different kinds of soil, capillarity, such phenomena as root absorption, the work of root hairs, leaf transpiration, leaf and stem conduction, starch manufacture and starch storage are topics whose classroom discussion and garden observation have a direct bearing on practical work.

This spring we had a strip of land 20′ x 125′, extending north and south, for school gardens. It was plowed for us but neither cultivated nor measured. The sixth grade measured all but the individual plots as an arithmetic lesson, and in arithmetic, not nature-study, recitation period.

Second Grade Cultivating

The second grade, a class of sixteen, cultivated its garden 15′x25′ by means of tools distributed to one-half the class, and by using sticks and their fingers for further pulverizing the soil. All were required to be busy during the entire lesson. When ready for planting the ground was carefully measured by the pupils, two of whom were delegated to place a string attached to sticks at each end, in order to make trenches straight. Four rows of radishes, four of lettuce, four of onion and seven of beans were planted. When time for weeding came, it was very convenient to assign one row to a child allowing the more rapid workers to weed the extra rows. Only the radishes and lettuce were mature when school closed. These were distributed to pupils to take home. Many interesting, helpful observations were made on the seedlings

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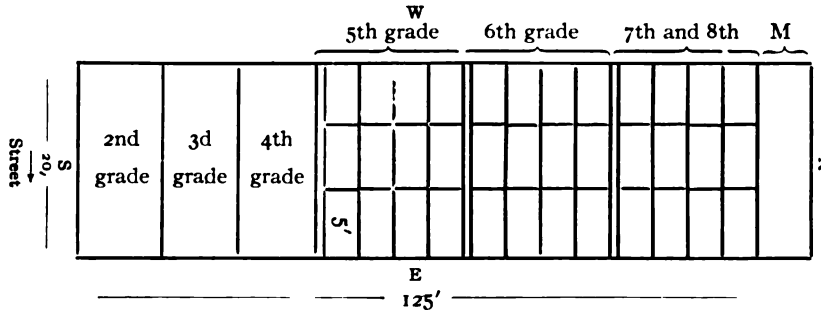

Plan of School Garden—Lewiston Normal, 1913

→ Drive. M—Miscellaneous: chiefly flowers.

especially beans, and several pupils had a close series of drawings (made in garden) showing development of a bean from the vertical position of the cotyledons to the establishment of true leaves.

Separated by a two-foot path the third grade garden, also 15′ x 20′ was next to the second grade. This class planted radishes, lettuce, onions and beets in equal proportions. The class order and work in the garden were directed just as in second grade.

Fourth grade, which had its garden next to third (a two-foot path separating them) planted it similarly. Four rows of radishes, four of lettuce, four of carrots and three of beets were planted.

Above fourth grade (and hereafter including fourth grade) pupils have individual plots of five by six feet. Just thirty-six plots were

Seventh and Eighth Grades at Work

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needed this year, twelve for each of the grades using them. Pupils measured their own plots, allowing for a one-foot path on all sides. As our strip of ground was twenty feet wide, it accommodated exactly three plots on their five-foot side plus two one-foot paths between them, (outside boundaries were provided for.) Cf. diagram. To give uniformity of appearance, all individual beds were plotted similarly and occupied that part of the garden beyond the class gardens; all rows both in class and individual gardens were made to extend north and south.

The list of vegetables given was as follows:

parsnips	onion
carrots	tomato
beets	peas
radish	beans
lettuce	egg plant
cabbage	parsley

Those vegetables chosen by the majority were of early maturity. In cases where later-maturing vegetables were chosen, it was done by children who expected to attend summer school or to come at garden time to tend their plants.

A child in fifth grade planted six rows of radishes; another planted six cabbage plants. A boy in sixth had two rows of fine-looking carrots and four of radishes. One of the neatest gardens belonged to an eighth grade girl who was raising two rows of peas, two of radish, and two of carrots.

After all assignments were made there was still fifteen feet of the strip remaining. This was profitably used for a miscellaneous garden and, with the exception of two rows of corn, had flowers only. As it was the north end and gave on an unsightly lot beyond, we planted tall vegetables there. Commencing with the northermost row and working southward (these rows running east and west) were planted one row of sunflowers, two of sweet corn, two of cosmos, one each of marigold, zinnia, Chinese pink and California poppy. As this part was the property of all classes and no one alone, pupils from all grades were allowed to work in it during a class period after they had finished their own work.

Although every part of the garden will fulfill the school aim, i. e. to supply material for nature-study and for other departments, yet the miscellaneous garden will do the most in this regard. To observe complete life histories of several garden plants, to study

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flower parts and to discuss the usefulness to man will be fall nature-study topics. Cosmos and other flowers blooming in September and October will supply specimens to the art department and through it to design and art needlework, just as last spring our flowering bulbs performed the same duty. As seeds ripen they will be gathered, packeted and labeled, furnishing thereby the opportunity of observing the abundant means of plant propagation and the conclusion to a study of life cycles. Sunflower and corn are plants admirably adapted to such study, especially for young children who work best with large fruits, while the smaller fruits and seeds will be studied most by older children who will also have more mature topics of study on the aforenamed plants.

Although the department of agriculture is separate from nature-study and furnishes vegetables to the domestic science department of the school, yet the children who cultivate vegetables to maturity will demonstrate at school their uses in the home and will briefly tell the processes necessary in their preparation for eating. Through gardening, a better understanding of parts of literature is achieved. Corn in connection with the story of Hiawatha is one instance.

The lessons about economically useful plants come frequently during autumn and culminate at Thanksgiving in harvest review lessons. Children are taught the names of parts of plants that are used for food. Tuber, bulb, underground stem and root are vividly understood because in each case a specimen typifies the group. Onion study introduces the study of flowering bulbs, important in autumn.

Not all garden work is directly plant study; those animals common in gardens are studied or discussed as the children find them. This year several practical lessons were based on angle worms, slugs, garden toads and wire worms.

A problem that confronts all engaged in school garden work is the care of gardens during summer. For us it is solved (1) by summer school continuing until August first; and (2) by having a man in charge thereafter until the autumn session. All children who can do so are urged to attend summer school or otherwise continue garden work.

Another problem that confronts workers in regions inadequately watered is irrigation. It is necessary for our children to irrigate their gardens but not difficult, for water is abundantly piped to the place needed.

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It is for the enthusiasm shown by every pupil for gardening, the practical training given minds and hands, and the economy thereby demonstrated; for the coöperation of this subject with other school studies and for the very close relation to and dependence upon members of the animal kingdom as admirably shown by gardening. that we unreservedly urge it to be a dignified part of every curriculum.

Booklets

ARTHUR D. CROMWELL

The term "Booklet" is used for a new kind of a note book. This new kind of a note book is attractive to small children. The idea came to us from Germany where in some places, the children make the text books. If we can save agriculture from our "text-book cripples," if we can get teachers to teach the subject instead of a book, then Agriculture will be a leaven that will help leaven the whole lump. The "Booklets" offer opportunities in so many directions. They are to have attractive covers and this enables us to appeal to the child's love for color, it enables us to let him be original, that is to do things somewhat as he pleases, in school. Our schools from top to bottom put a premium on conformity to standards instead of on originality and invention. I understand that no school or college in America has a course on invention. Well in the "Booklets" we may let the child be an inventor. Then again we are rearing a generation of property-less children and we have a crime bill that costs us about $2,500,000,000 each year. It is said that 85% of this crime is committed by children and about 50% of it against property. The child is to own his "Booklet" and to have his property rights rigidly respected by teacher and school.

There are many subjects that make good booklets. How to Win in an Acre Corn Contest, How to Manage Poultry, How to Win in a Bread Making Contest, or any other of a hundred topics, make a good topic for a booklet. The children should be told that their "Booklets" will make a record of their work and be used for school, county institutes, fairs and other exhibits. These "Booklets" change at once the will of the child. Instead of being driven like a slave to do his school work, he has implanted in him the desire to write well, to spell correctly, to use good English, to have his work,

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neat, clean, and worth while. The National Department of Agriculture is doing a wonderful work among the boys and girls, by means of the "Booklets." Mr. O. H. Bension has issued a circular on "Booklets" and how to make them.

Here in the Pennsylvania State Normal, we have the young people who are preparing to teach, make lesson plans on the different subjects and then bind the lesson plans on one subject together

Booklets of an Eighth Grade Pupil

for a "Booklet." For example, we made lesson plans on Poultry—Poultry Farming vs. other Farming, How to Select Hens for More Eggs, How to Judge Poultry, How to Feed for More Eggs, Housing Poultry, Running an Incubator, etc. We do the same with Cattle, Horses, Soil, etc. The aim is to enable the teachers to go from the Normal School with some lessons so organized and learned that they can teach them and teach them well. Sixty or one hundred well organized lesson plans do not make a bad start for a young teacher whose state requires her to teach Agriculture to the seventh and eighth grades at least two times each week.

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A Collector's Experiences

CLARENCE M. WAITE
Student, Syracuse, N. Y., High School.

My employment, outside of school hours, is one that few people have ever heard or thought of. You know that various kinds of insects, reptiles and other things, are used in the biology and zoology work of the schools and colleges throughout the land but did you ever stop to wonder where all this material came from? There are quite a number of men employed in catching these things and a more interesting business would be hard to find. On the following pages I shall tell of a few things that I have seen during my short time as "bugologist," as many of my friends call me.

Perhaps the oddest and least known of our common insects is the walking stick; there are those who have a vague idea that it is peculiar to tropical countries and is never seen here outside of a museum. Within two minutes' walk of my house is a hillside covered with beautiful, large oak trees and it was here that I found my first walking sticks. Long, thin, with legs like hinged tooth-picks and colored light green or a shiny brown, they may seem difficult to find but this is not the case. In the early summer they may be found on the trunks of trees, hanging head downward with not a visible motion. If a hand is stretched toward them they flatten against the bark and then drop to the ground, even though they may be several yards up the tree. It is necessary then to look for them immediately for among the twigs on the ground they really are difficult to find and they walk off as soon as they land. They are very light and when falling spread their legs, which seems to check their descent a trifle, although the legs are by no means feathery or fan-shaped. In the fall they descend from their higher perches and cover the bushes under the trees, hanging, as usual, head downward and being extremely difficult to see. It is at this time of the year that the eggs are dropped to the ground where, Prof. Clarence Weed says, they remain till spring before hatching. I have found many of these bizarre creatures with a half or whole leg missing, which doesn't seem to bother them in the least. I have found them only on the oak trees but they also eat the leaves of many other trees, as peach, elm and birch, and a nearby gardener says that there are large numbers on the leaves of his garden vegetables but states that they seem to be doing no injury.

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People are surprised that I should spend my time hunting walking sticks but when they see me after grasshoppers they look wise and then ask if I am going fishing. I caught several hundred red-legged grasshoppers during last summer and, needless to say found out many new things concerning them, perhaps the most interesting of which is the way they try to escape from an enemy. They are in the habit of hanging on the tops of bushes or blades of grass, by means of their short, hooked front legs. When disturbed they drop either straight to the ground or by two or three relays, swinging from one branch to another, until they land, and then hop into the denser brush. If they are disturbed while in the grass they dive straight downward and pushing their noses into the blades where they are closely matted together, shove with their powerful hind legs until they are entirely out of sight. Sometimes they burrow for several inches in this manner and if not watched carefully will be lost entirely. When a hand descends on a grasshopper he usually jumps, so when I pounced on one once and it did not move I was a little surprised. Upon removing my hand and looking a little closer I found that it was a female with the end of its abdomen inserted in the black soil, which had been trodden down to a hard path. Coming back a few minutes later I found the hopper gone and a hole left, smaller around than a pencil and perhaps an inch deep, at the bottom of which was a cluster of small eggs; these would have hatched the following spring if left undisturbed. They were bunched together, oval-shaped and colored

Reproduced Nat. Size Fig. I. Katydid

Photo by J. C. Evans, Syracuse High School

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a dirty white; I carried some to school and found that they were the first that had ever been brought in. Of similar habits are the katydids. Fig. 1.

An insect very much confused with the grasshopper is the Carolina locust. They have conspicuous brown wings with a yellow border, and fly instantly on approach; but even when they have lighted they are still hard to get, for their dust-colored backs blend perfectly with the dirt or sticks they may be on. I had found several old locusts hanging on bushes but never knew what the trouble was until I read a book by Prof. Clarence Weed. He says that a parasite eats the tissues of the locust's body until only its skin is left hanging somewhere.

The life history of the Monarch or Milkweed butterfly has been described by every writer on insects but there are probably still many persons who have never heard it and still fewer have had the pleasure of seeing the complete metamorphosis. Late one summer after I had returned from my vacation I found several larvæ of the Monarch feeding on the milkweed leaves in a nearby lot. These I carefully gathered and put in a large fish globe, the top of which was then covered with a card-board pie plate punched full of small holes. It was a crude arrangement but worked splendidly, all but two of my caterpillars becoming adult butterflies. For several days they ate the milkweed leaves I provided and then the larger ones were ready to pupate. Climbing to the top of the globe, or still farther, onto the pie plate, each one spun a tiny mat of silk and entangling his hind legs in this, hung head downward for a day or two. Then with much wriggling and squirming, the old black, yellow and white striped skin was thrown off and a coat of beautiful pale green, dotted with golden spots, took its place. Fig. 2. In the meantime the smaller larvae, having been eating steadily, had grown larger and each of them needed a new skin, as the old one would not stretch. So they stopped their feeding long enough to moult, and then started again as voraciously as ever. Soon all were chrysalids, but while the younger ones were green the orange wings and black veining of the developing butterflies were showing through the coats of the others and it was not long before the adults emerged. At first their wings were soft, small as a finger nail, and shapeless, and the bodies flabby and thick, but as they slowly forced their wings up and down, pumping blood through their bodies, they grew and hardened and the bodies lengthened.

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Then almost without warning, they launched off into the air as though flying had always been their mode of traveling. I raised about twenty-five butterflies that fall in this way but it was not until the following summer that I found the first stage, the egg. I noticed one day a large Monarch floating from one milkweed plant to another, not stopping for the honey in the flowers but seeming to rest only an instant on the leaves, with its abdomen curved around and pressed against the surface. I guessed immediately that she was laying eggs but it needed a very close inspection to prove this, as the rather sharp, cartridge-shaped egg was too tiny to

Fig. II. Pupa of Monarch *Photo By J. C. Evans*

be noticed at once. It was pure white but later turned to a dull yellowish. The first summer the Monarchs were quite plentiful but the following year I saw very few and found only two larvæ the whole year, but now the nymph butterflies were abundant and their larvæ covered the nettles near the house. I raised these as I had the Monarchs, and often five or six were flying about the room. At the same time I was keeping some black swallow-tail larvae that had been found on some wild parsley and although many of these pupated before the nymphs, none of them emerged that fall while all the nymphs did. On September fourth, I carried

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a Monarch larvae to school and on the twelfth it pupated, and finally emerged on the twenty-fifth, showing that only a short time is needed for it to grow. The earliest butterfly is the Mourning-cloak, which hibernates during the winter. I saw several of these around last Easter and they are sometimes seen during a warm spell in the spring.

The spider is a much detested and ill-treated animal, notwithstanding the fact that it kills myriads of the disease carrying house-

Fig. III. Adult Monarch *Photo by J. C. Evans*

flies. If you wish to see one of the most beautiful works of Nature stop and look carefully at an orb-spiders web. Built in concentric circles of sticky, elastic threads with a framework of stiff, unyielding material, it is well worth a close examination. It does, indeed, seem sad that such a thing of soft, delicate appearance, should be used as a murderous trap, but the spider has as much right to live as anything in this world. I have watched with interest though hardly with much pleasure, an unwary fly or grasshopper fall into

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a web and by its struggles bring the spider to it. She climbs round and round the victim, covering it with a broad, sticky thread which holds it tightly; then after biting it to kill it she returns to her lookout in the center of the web to await more prey. I have seen a large grasshopper jump into a web and get his head tightly wound up but he could not be held by his legs because he kicked so vigorously. Again and again he kicked off the thread but is finally exhausted and struggling weakly is bound up closely. The orb-spider encloses its eggs in large numbers in a round case about as large as a marble and hangs it on a bush. I have opened one of these cases in the middle of winter and found the eggs already hatched and a multitude of tiny spiders resting in it. These spiders drop from their webs to the ground when disturbed and I have caught most of mine by placing a cyanide jar under them and touching them, when they drop straight down into the jar; in this way I can catch thirty or forty an hour, where they are numerous.

The dragon-fly is an insect which is little known and appreciated. It is commonly called darning-needle and is supposed to have the power to sew up children's ears. Despite a belief to the contrary there is no insect less harmful to a person. It cannot bite, sting or hurt in any way, anything, except the small flying insects it lives on. These are caught and eaten while on the wing and it is while hunting food that these insects are most beautiful, sweeping, darting and turning over meadow or pond, their bluish or greenish bodies glistening in the sunlight. They are noted for their flying abilities; often when I have swung a net at one it seems as though he has turned at right angles and is next caught sight of fifty feet away. Their large compound eyes permit them to see in every direction and increase the difficulties of catching them. One day I got one more easily than usual and thinking it might have a broken wing I cautiously looked into the net and saw that the cause for an easy capture was the fact that it had been eating an insect and was probably not paying much attention to things around. The little winged bug was still held tightly in its front legs and would soon have been finished. In the spring the female dragon-fly swooping closely over the water's surface dips in the end of her abdomen at short intervals and deposits an egg. In due time this hatches into a "nymph," which lives in the water for some time and then climbs into dry land and changes to an adult.

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I labored hard trying to dig up some angleworms but didn't have much success until a friend told me how to get them easily. Under her direction I dissolved a heaping spoonful of mustard in a couple of quarts of water and poured it on the ground where I knew there were worms. Almost instantly heads began to appear and bodies to follow the heads; they actually seemed to shoot up through the ground and wriggle off across the surface.

Another pretty animal is the little salamander, commonly but incorrectly called a lizard. Its black eggs, floating in a jelly-like substance on the water, can hardly be distinguished from those of the frog, and like the frog, its early life is spent as a tad pole. After that it leaves for land and lives in a stump, under rocks or in holes or caves. Now it turns a bright red, with three rows of spots down its back. I could find very few of these although I hunted carefully, for a professor at school wanted some to try to discover the development of the color spots on its back. Following a brief stay on land it returns to the water and turns dark grayish; now they are easily found and I have caught all that were needed with no trouble.

Although, of course I have never caught or killed any birds for biology work, I am greatly interested in them, more so in fact, than in any other wild thing. I will not tell of my experiences with them, for more interesting reading than this can be found in any library, telling of the beauty and intelligence of birds, but a list of the birds I have seen in and around Syracuse might prove of value to some. The following is for the year 1912:

Jan. 20 Chickadee.
Feb. 3 Crow.
Feb. 9 Junco.
Mar. 19 Robin.
Mar. 30 Song Sparrow.
Apr. 5 Herring Gull.
Apr. 10 Fox Sparrow; Hawk (kind not known).
Apr. 14 Bluebird; Wild Duck.
Apr. 23 Flickers; Grackles; Red-winged blackbirds; kingfisher.
Apr. 25 Vesper Sparrow.
May 1 Barn swallow; Ruby-crowned kinglet; white-throated Sparrow; chipping sparrow; meadow-lark; partridge.
May 4 Bank swallow.
May 6 Yellow warbler; catbird.
May 8 Brown thrasher; screech-owl; wood thrush; yellow-bellied sap-sucker; baltimore oriole; chestnut-sided warbler; white-crowned sparrow; chimney swift;

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Cape May warbler; wood pewee; black and white warbler; magnolia warbler; red-breasted nuthatch; house wren; downy woodpecker; gold-finch.
May 9 Cedar waxwing; great blue heron; spotted sandpiper; mourning dove.
May 10 Bobolink; phoebe; kingbird.
May 11 Rose-breasted grosbeak.
May 19 (Fifty miles from Syracuse) Indigo bunting; purple martin.
May 25 Teacher bird; yellow-breasted vireo.
May 26 Scarlet tanager; black-billed cuckoo (?).
June 24 Maryland yellowthroat.
Aug. 24 Barred owl; red-eyed vireo.
Aug. 28 Pine warbler.
Dec. 28 Tree sparrow.

Every walk in the country or even along the street is made more interesting if one has even a slight knowledge of the things around him. Old things are viewed with renewed interest and new things are hailed with joy. If you do not care for insects, the flowers and trees are always beautiful, while even the shapeless rocks in the field have charms if you but know them. As I have said before, the birds are my favorites but they are not always handy; for every day pleasure you should acquire a certain amount of knowledge of all things of Nature.

How to Grow Some Common Moulds

Report of Address by Mr. Tabor, B.Sc., Royal College of Science:

The study of moulds is possible even in schools where no microscope is available, and by such study certain facts of elementary physiology can be taught, *e. g.*, the advantages of different kinds of food material, the effect of temperature, light, moisture, etc.

For the minute study of moulds a compound microscope is necessary, but much biological work can be done with simple lenses. The choice of food material is not of very great importance, as moulds are found on so many different things—jam, boots, etc. Bread is perhaps more suitable for the purpose and gives excellent results. It should be moistened, then rubbed over a dusty shelf. In this dust the spores of some of the commonest

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moulds are sure to lie. The bread should then be placed in a soup plate and covered either with a tumbler of glass or another soup plate.

In all probability white moulds—some species of mucor—will first appear, and following upon these, and when a good deal of the moisture has been abstracted from the bread, blue green moulds—species of penicilium, and olive green moulds—species of eurotium.

If a more minute study of moulds is intended it is well to obtain a pure culture, and for this purpose the sterilization of both material and apparatus is necessary.

The bread should be baked in an oven until nicely toasted, and in this way all spores will be killed. Then a few of the spores for special study, and of one kind of mould only, should be transferred on a needle, whose point has been passed through a flame, from a piece of mouldy bread to the toasted bread, which should be slightly moistened. In order to exclude all other strange spores, the cul ture should be put in test tubes which have been sterilized and scalded.

To sterilize the test tubes, place a number of them in a jam jar or beaker, put the latter in a sauce pan of water, and keep it boiling for one hour. Then put pieces of bread, potato, fruit or vegetable, to which spores have been transferred, into the tubes and scald them.

If it is desired to watch the progress of the growth of the spores, they can be grown on some transparent medium—apple jelly produces good results—placed in a small shallow glass dish covered with a tight fitting glass lid.

Although at first one may not succeed in obtaining an absolutely pure culture, yet it is certain that where care has been taken, the individual plants of the particular culture will far outnumber all others.

For more detailed instruction in this subject, readers are referred to leaflet No. 17, written by Mr. Tabor, and obtainable from the General Secretary.

From *School Nature Study*, Feb., '13, London, Eng.

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School Gardens

1. In order to secure a position in a school garden, an applicant must have a teacher's certificate or show qualifications equal to a Normal School training. Teachers who, besides their Normal School training, have also completed a course in school gardening, will be placed first on the eligible list.

2. In the school gardens each class of children receives lessons in nature study or elementary agriculture, and does practical garden work. Because of these lessons each principal or teacher must have such a knowledge of botany and elementary biology that she readily can give these nature study talks. This botanical knowledge need not be very scientific.

3. Practical gardening experience in raising vegetables and flowers is very helpful for teachers, but it is not an absolute requirement. Teachers possessing the practical as well as the theoretical knowledge are, however, the most successful teachers.

4. Applicants for positions should realize that school garden work is of a very strenuous nature, and that no one incapable of bearing a prolonged mental and physical strain should apply.

5. The school garden season is from about April 7th to October 7th; *i. e.*, six months.

6. Hours of principals: April, May, June, September and October, school days, 9–12; 2–5.30. Saturdays, 9–12. July and August, 8–12.30. Hours of teachers: April, May, June, September and October, school days, from 3.30 to 5.30; Saturdays, from 9 to 12. July and August, from 8 to 12.30.

7. The salary is based on efficiency, ability and experience in garden work; principals, teachers and gardeners are accordingly divided into three classes—A, B, and C.

Principals per month A, $75.00; B, $70.00; C, $65.00.
Teachers per month, A, $42.50; B, $40.00; C, $37.50.
Gardeners per month A, $55.00; B, $52.50; C, $50.00.
Landscape gardener, per month, $60.00.
The salaries of substitutes per day are as follows:

Principals—April, May, June, September, October, $2.50; July and August, $2.00.

Teachers—April, May, June, September, October, $1.00; July and August, $1.50.

Gardeners, $1.50.

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8. As a rule there are a principal and two teachers in each garden, while one gardener is attached to every two gardens. The principal and one teacher are always in the school garden proper. The second assistant teaches the children how to make their home gardens, and she systematically visits them.

9. Each school garden contains from 85 to 200 individual plots eight by ten feet. In addition, it usually has sixteen class plots, sixteen sample plots, and borders running along the four sides and through the middle.

10. During the school months, April, May, June and September (except Saturdays), the daily program is as follows:

9.00 to 12.00
2.00 to 3.30 — Kindergarten and primary classes visit a neighboring garden, the visits lasting from one-half to one hour. Ten or twenty minutes are devoted to Nature Study; these lessons follow a systematized plan, a regular course being developed grade by grade. Twenty to forty minutes are then given for practical garden work on class plots.

3.30 to 5.30 Work on individual garden plots.

11. On account of the large number of children holding individual plots in each garden, they are divided into four classes, two classes coming on alternate days. The "First and Third classes" consist of children who have been in the garden at least one season. The "Second and Fourth classes" consist of children who are in the garden for the first season.

General Program

The daily program during vacation, July and August, and also on Saturdays, is as follows:

First and Third Classes:

8.00 to 8.20.—Reading or telling stories.

8.20 to 8.40.—Nature study lesson

8.40 to 9.35.—Individual plot work.

9.35 to 10.00.—Work on borders and sample plots.

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Second and Fourth Classes: 10.00 to 10.20.—Reading or telling stories.
10.20 to 10.40.—Nature-study lesson
10.40 to 11.35.—Individual plot work.
11.35 to 12.00.—Work on borders and sample plots.
12.00 to 12.30.—Inspection and clerical work.

—From *Pamphlet of Information, Board of Ed., Phila.*

Editorial

The term Nature-Study has come to have a very definite meaning. The layman as distinct from the scientist goes out to spend his holiday or his vacation in fields and woods. His amateur observations, his appreciative study of the things about him is in the spirit of nature-study. But, in school parlance, the term has come to have a still more restricted significance. It is the subject matter dealt with in a particular school period in the daily or weekly school program. Nature-Study must perform, therefore, a definite scholastic function, must help fulfil the ends of education. Now the nature study both of the amateur and of the school-boy leads on to science if long pursued. It is a sort of selected science stripped of forbidding technicalities, pregnant with human interests, aesthetic pleasures and moral import. It must do for the child in school, in so far as it is possible, what science helps to accomplish for the more mature student. It must drill him in the method of and habituate him to independent thinking, widen his sympathies, sensitize his conscience, fit him for social responsibilities.

Nature-Study should not be carelessly given a place in the curriculum nor taught without a realization of the responsibilities assumed. The teacher should be aware of what she is trying to do, should move in its accomplishment with no uncertainty and should test out her results to assure herself that she is doing what she sets out to do in her teaching. In this, as in other topics, it is to be feared that the teacher is prone to acquire facility in the subject

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matter sufficient to accomplish the daily tasks and stop short of the wide vision. So her pupils are doing humdrum work under a taskmaster rather than having stimulating contact with a mind that is alert and fired with the touch of the infinite.

It is eminently desirable, then, that every teacher undertaking to give instruction in nature-study should select some little field of nature—the warblers, the ferns of her region, the butterflies, the common rocks and come to know this one restricted field intimamately. Let her take as models some of the studies in William Hamilton Gibsons "Eye Spy" or "Sharp Eyes." Read them with due regard to their scientific accuracy, their literary charm and the artistic expression of the accompanying sketches. Let her study in the field frequently some individual plant or animal then try to accomplish some such sympathetic description and sketches of it. Only in some such way can she be led to right methods in the instruction of little children. She must come in touch with the contagious enthusiasm, the fidelity, the artistic appreciation of some great nature lover, either personally or through his books else the coal of fire can never unseal her lips.

Then I would have her study some book that will lead her to see what great problems are hidden in these commonplace things about us. Take, for instance, Darwin's Origin of Species, Wallace's Island Life, Bateson's Heredity or Walter's Genetics. So may she be inspired to observe that she may reason to correct conclusions. Thinking thus she may stimulate her pupils to think independently on a basis of their own observations, to draw just conclusions from the evidence of their own consciousness. What larger contribution can she make to the welfare of a democracy?

News Notes

The Buffalo herd on the Wichita national forest, Oklahoma, now numbers 48, 10 calves having been born this year. When the buffalo were introduced on the Wichita in 1907 there were 15 head.

The Grand Rapids Nature-Study Society and the Nature-Study Club of Indiana issued very neat programs for season of 1912-13. Similar programs are expected for the present year.

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In the year *1906* (July 1, 1905, to June 30, 1906), the first full year after the forest service was put in charge of the forests, *the timber receipts were about $250,000*, in the fiscal year *1907 something less than $700,000*, and in *1908 about $850,000*. In *1909* timber receipts dropped back to less than *$750,000*, but in *1910 and again in 1911 were over $1,000,000, and in 1912 were nearly $1,100,000, as against about $1,250,000 for the year just closed.*

Nature Study Corner in District No. 4, Quincy, Mich.
Miss Bessie B. Kanouse, Teacher

I am enclosing a picture of our nature-study corner that we arranged last year in a one-room country school. While the picture does not show nearly all there is to be seen, it may give you something of an idea of what we did, and I thought it might be of interest to you.

It was the first work of the kind ever done in that school, or as far as I know, in the county, and the children were delighted with it. I will be glad when more work along nature-study lines can be done in the schools.

Bessie B. Kanouse,
Quincy, Mich.

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C. H. Robison,
State Normal School,
Montclair, New Jersey.

C. H. Robison, State Normal School, Montclair, New Jersey, spent a few days in Virginia during their Rural Life week. He gave a lecture with slides explaining the growth and present status of the agricultural movement in secondary schools, based on his work in Bul. 6 of the Bureau of Education. He spent a period with several classes talking on methods of using insect material in nature-study and agricultural classes. Evening lectures on Insects were also given.

The Grand Rapids Nature-Study Society was organized in September, 1912. Much interest was manifested at the time of organization and this spirit continued throughout the year.

The evening programs included five addresses by men representing different nature-study interests. Those who favored us were Dr. Otis W. Caldwell of Chicago University; Wm. E. Præger, Kalamazoo College; Walter A. Sperry, Grand Rapids; Henry Oldys, Silver Springs, Md.; and Dr. Leroy Harvey, Kalamazoo Normal. Two general excursions were a delight to all who participated. The first, in October, conducted by Miss Frances Stearns was along the River Road to Belmont; the second to the Fish Hatcheries in May, was conducted by Dr. Leroy Harvey.

During this past year the membership consisted mainly of teachers who wished to receive help on various phases of nature-study. In order to accomplish practical results, sections for the study of Plants, Insects, School Gardens, Physiography and Birds were organized. A chairman was appointed for each section who had attained some degree of proficiency in her subject. Members had the privilege of joining one or more of these sections, each of which met once a month for study. Many of these afternoon meetings were a source of much pleasure and benefit.

The Plant Section devoted most of its time to tree study, three of the meetings being field excursions. The interest of the Insect Section centered in the study of moths and butterflies. The chairman of the School Garden Section organized the first co-operative School Garden in the city. For this a vacant lot was selected in a neighborhood having within its radius several school buildings. Fifteen boys responded from these different schools. Members

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of the Bird Section participated in six field excursions and four meetings for identification of museum specimens. At the request of the chairman of this section, Mr. Herbert Sargeant, director of the Kent Scientific Museum prepared cases of mounted birds for distribution in the public schools. A plan of distribution was carefully worked out and tried in the Spring term. A printed description will be added to each mount this year and we believe that this will prove the beginning of a more extended use of museum material in the schools.

ORA MAY CARREL, *President.*

Book Reviews

Beginnings in Animal Husbandry, by Charles S. Plumb. The Webb Publishing Company, St. Paul, Minn. 393 pages. Price $1.50.

We have had a number of books issued in the last few years on agriculture in the schools, and now there begin to appear books for common school use on various special phases of agriculture. Mr. Plumb is already well known as a writer on this topic and this book which he puts out is quite as interesting as its predecessors. Chapters 2, 3, 4 and 5 are devoted to the breeds of horses, cattle, sheep and swine; 7 discusses the judging of livestock; 8 and 9 are devoted to judging the horse; 10, 11 and 12 judging cattle, sheep and swine respectively. Chapter 13 (9 pages) discusses heredity, its meaning and influence. Chapter 15 is on pedigrees; and there follows a brief chapter on suggestions to young breeders. Then follow seven chapters on feeding. The last five chapters are devoted to poultry, various types and breeds, poultry judging, egg production, feeding and housing.

The book is well illustrated. The style is simple and any school boy will appreciate a great deal of the information. Like all books of this type it is necessarily encyclopedic, and unless it is in the hands of an experienced teacher there is every probability that it will be used as an ordinary textbook, studied by memorizing and glibly recited without much reference to the actual materials under discussion. If it can be used merely as a guide in the actual study of the materials discussed it certainly will be a valuable aid in many schools.

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Animal Husbandry for Schools, by Merrit W. Harper. The Rural Textbook Series, L. H. Bailey, Editor. Pages 409. The MacMillan Co. Price $1.40.

This is another excellent book on animal husbandry. The order of treatment is much the same as the preceding. The first five chapters are devoted to the horse and his kin, discussing the breeding, judging, feeding and care. Chapters 6–11 inclusive discuss similar topics for cattle; 12–15 inclusive, sheep; 16–19, swine; 20–23, poultry. There is an appendix of 60 pages including valuable reference tables, and 32 pages of laboratory exercises. This is a particularly valuable part of the book and will help even the inexperienced teacher to accomplish actual field work on the subject. Presumably these books on animal industry will more or less occupy the place heretofore given to a more general study of animals. The experiment will be watched with great interest by teachers to see in how far these commonplace materials of the farm will vitalize the animal study, and whether our educational results will be any better with horses, hogs and poultry than it has been with the subject matter of the ordinary zoology text.

Genetics and Introduction to the Study of Heredity, by Herbert E. Walter. Pages XIV plus 272. The MacMillan Co. Price $1.50.

This book is based on a course of lectures given at Brown University, winter of 1911–12, and repeated the following summer at the Summer School of Biology, Cold Spring Harbor, Long Island. It seems the best popular presentation of this subject of heredity that has yet appeared, and while popular it is also thoroughly scientific. The reviewer does not know of any book that would be more stimulating to the average student and that would better enlarge a teacher's vision of the significance of nature in its present day problems than this book. Chapter 1 defines the field of heredity; chapter 2 discusses the carriers of the heritage, the chromosomes; 3 is on variation and shows how this topic at foundation is based on heredity. Chapter 4 discusses mutations; 5 the inheritance of acquired characters; 6 the pure line; 7, segregation and dominance; 8, reversion; 9, plant inheritance; 10, sex determination; 11, the application to man; 12, human conservation; 13 gives a good though, brief bibliography.

The style is simple and clear and the reader must gain a pretty accurate insight into the present problem of heredity in so far as this can be given in book form.

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A few errors need correction in the revision: the diagram on page 23 shows only one generation of spermatocytes, and a division of the spermatids. There should be two generations of spermatocytes corresponding to the two of the oocytes and the spermatids transform to spermatozoa without division. Page 24 has a corresponding mistatement that the number of chromosomes "remains constant in each germ cell respectively until the division of the spermatids into spermatazoa." Spermatids do not divide to form spermatazoa, and the number of chromosomes is reduced to one-half the somatic number when they appear in the spermatocyte of the first order preparatory to its division. These two are the most glaring errors the reviewer has noted. On page 123 is a typographical error, the date of the appearance of Mendel's results given as 1886, should be 1866, as indicated in the footnote.

Mendel's Principles of Heredity, by W. Bateson. Pages XIV plus 413. Cambridge University Press, 3d edition. Price $3.50. G. P. Putnam's Sons in this country.

It speaks well for this book that a third impression is necessary so soon. Professor Bateson has been one of the most enthusiastic English investigators and he himself has added materially to our knowledge of Mendel's law and its limitations. He has taken as his chief materials for investigation the color of flowers, and much of the material in this book is drawn from his own work. There is an historical introductory chapter; then a careful presentation of Mendel's law, with a review of practically all of the work that has been accomplished in confirmation and extension of the law. Chapter 9 is on gametic coupling. Chapter 10 treats of heredity and sex. Chapter 12 discusses the evidence of Mendelian inheritance in man. Chapter 14 is especially valuable; it is on the miscellaneous exceptional and unconformable phenomena. Thus far the book does not differ materially from the earlier edition, but there is added an appendix in which there is given in the order of treatment in the body of the book a series of summaries of the work accomplished since the second edition bearing upon the questions discussed. The bibliographical sketch of Mendel together with a reproduction of Mendel's original paper, translated, makes the book particularly valuable. There is also given a full bibliography, pages 385 to 402. This is a somewhat more scientific presentation of the subject than Walter's treatment, reviewed above, yet the style is clear so that it makes fascinating reading.

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Stories of Woods and Fields, Elizabeth N. Brown. 192 pages. World Book Co., New York. $ .40.

This is one of a series of text books on nature for use in the lower grades. It is a very attractive little volume of one hundred ninety-two pages, with sixteen beautiful color pages, many other illustrations and excellent print. The book contains sixty-nine short stories and poems of plants, insects, spiders, reptiles, birds, amphibians, mammals and a few history and holiday stories. The stories are well written in such a way that children may give free easy expression to their readings. While the book deals truthfully with nature-study subjects with which children are somewhat familiar it appeals to the child's interest and curiosity so that later he will search for those things, in the real book of Nature—the out-of-doors. B. B. K.

Plants, Their Uses, Frederick L. Sargent. P. X + 610. Henry Holt & Co. Price $1.25.

This book is an attempt at cataloging a large number of facts about useful plants and passing them out as economic Botany. The treatment of the subject is based almost entirely on the principles of systematic Botany. The economic phase, so far as it may be called such, consists of a list of illustrations, descriptions, and uses of most of the plants that are beneficial or harmful to man. A glance at the chapter titles will give one a fair idea of the contents. Chapters I on nomenclature and XIII on relations of organic to inorganic realms have little or no place in a high school text. The other chapters are: II, Cereals; III, Food Plants; IV, Flavoring and Beverage Plants; V, Medicinal and Poisonous Plants; VI, Industrial Plants; VII, Classification and Description; VIII, Parts of a Seed; IX, Crowfoot Family; X, Various Plant Groups; XI, Kinship and Adaptation; XII, Life Histories.

The first half of the book is taken up by the first six chapters on some phases of useful plants, the last half by classification and evolutionary topics and life histories. This leaves out the more important features of morphology, physiology and ecology. Three pages are given to the study of Bacteria. The practical phases such as plant breeding, cultivation, etc., have been entirely omitted.

This is certainly one of the most radical of books offered as a high school text today. It is one of those many books that are valuable on the teacher's shelf, but an impossible text in the hands of any ordinary class of high school pupils. In fact it is not a text book but a compendium of facts and illustrations of plants, both

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of which are good so far as they have a part in education. Principle and not fact should be the basis for the organization of a text book and this book has overlooked the one fundamental thing for high school Botany, namely, that the plant is an actual, living, working organism. It merely treats the facts about the plants without saying very much about the activities of the plant itself. Again the demand of the secondary schools for a more practical Botany has received little or no attention.

The illustrations are very good and there are plenty of them. The facts presented seem to be up to date and written in a readable manner except in a few cases where the subject matter is surely too difficult for high school people. One other very undesirable feature in the book, however, is the work on plant formulae. Such material as this has no place in a beginning Botany. Too many other things of greater importance demand the efforts of those who can only spend a short time in the study of plants. About the most that can be said for the use of this book in the high school is that it would certainly be a valuable reference work. C. E. M.

Mighty Animals, Jennie Irene Mix. 143 pages. American Book Company.

The author has succeeded in depicting the life that was lived on the earth before man appeared and she has placed before the public a volume which not only fascinates the reader but awakens his interest in facts relating to various forms of life. Many references which relate to fundamental concepts of geography, geology, botany and zoology will be remembered, for a child and many grown-ups prefer to get their knowledge in story form. By interweaving stories of difficulties encountered in securing these records Miss Mix tells of the mighty animals of past ages, their habitats and lives in such a manner that they will attract the keenest interest of boys and girls.

The story begins with the mightiest of these early creatures, the Dinosaurs, which disappeared millions of years before man lived on the earth and closes with the Mastodon and Mammoth, the ancestors of elephants of our own time. The painstaking care in selecting material and the sources from which her material was gathered gives to us a book of real educational value.

The scientific names which might seem unsurmountable have been given a page at the end of the book with diacritical marks and very little time will be required to master the pronounciation.

O. M. C.

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THE NATURE-STUDY REVIEW

DEVOTED PRIMARILY TO ALL SCIENTIFIC STUDIES OF NATURE IN ELEMENTARY SCHOOLS

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VOL. 9 NOVEMBER 1913. No. 8

Annual Meeting and Election of Officers

For several years past the American Nature-Study Society has held its annual meeting in connection with the meetings of the American Association for the Advancement of Science and Affiliated Societies which convene during the first week in the year. This year, however, these societies are to meet at Atlanta, Ga. It is anticipated that so few of our members will travel thus far to the meeting, that it would be unwise to attempt the conduct of a program there in keeping with the dignity of the annual meeting Aside from the papers usually presented little business needs attention. That little can be conducted through the pages of the REVIEW. Arrangements are already completed for the publication in the REVIEW of a series of articles by members of the Council that will amply compensate for those usually read at the annual meeting. These, too, will be presented to the larger audience.

The most important business to be transacted is the annual election of officers. The officers at present are as follows:

President, Anna B. Comstock, N. Y.; *vice-presidents*, M. A. Bigelow, N. Y.; Otis W. Caldwell, Ill.; Stanley Coulter. Ind.; B. M. Davis, Ohio; C. H. Robinson, N. J.; *directors*, E. E. Balcomb, N. C.; L. H. Bailey, N. Y.; Ora M. Carrel, Mich.; Anna Clark, N. Y.; J. A. Drushel, Mo.; C. F. Hodge, Mass.; Alice Jean Patterson, Ill.; S. C. Schmucker, Penn.; Grant Smith, Ill.; Susan B. Sipe, D. C.; W. J. Stevens, Mo.: G. Straubenmueller, N. Y. Laura E. Woodward, N. J.; *secretary-editor*, Elliot R. Downing.

The terms of office of the following ones of these expire with the present year and they must be re-elected or their successors chosen. The president, five vice-presidents, secretary-editor and these

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directors, L. H. Bailey, J. A. Drushel, C. F. Hodge, S. C. Schmucker, Laura E. Woodward. The list of nominations (made by the Council) together with a ballot will be published in the December number. All subscribers to the magazine are entitled to vote.

The Bracket Fungus, a Lesson in Civic Duty

ANNA BOTSFORD COMSTOCK

Of all organisms, the trees best lend themselves to lessons in social welfare. So long is the life of a tree that when one is planted, it is for the benefit of the next generation rather than for our own. And all of this movement for conservation of forests and public lands is for the good of the future citizens of our republic for cen-

The Bracket Fungus
Photograph by Verne Morton

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turies to come. Teachers miss a great opportunity for teaching useful citizenship when they fail to interest their pupils in this great plan of our government for forest conservation.

Another phase of the subject which may be of real use in teaching civic duty is the proper care of trees; not merely of our own trees but of all trees.

In nature-study we make much of the importance of trees to the birds and animals as well as to ourselves. The wild cherry tree gives many birds their food; the shagbark by the pasture fence gives food to the squirrels and chipmunks, and provides a welcome shade for the cows and horses grazing there. In fact, the first year's work concerning trees is to show the children their uses to wild life as well as to the life of the domestic animals and ourselves. The next step is to establish a desire that the tree shall remain, long after our interest in it ceases. If we realize that the old elm by the schoolhouse door may live to shelter and give swing-privileges to our grandchildren and our great grandchildren, we shall certainly love it all the more.

One of the ever present enemies of all trees is the spore of the bracket fungi. These spores seem to be sifted everywhere, but their one chance to become established in a living tree is through a wound in its bark. This wound is sometimes made by the breaking of a branch by the wind, but it is far oftener made by the hatchet or axe in a careless hand. The child should become so filled with the sense of danger to which a gaping wound exposes the tree that he will at once wish to give it proper treatment as soon as he sees it, no matter whether the tree is on his own land or not. It would be well to establish among the children of the third and fourth grades a club for giving first aid to wounded trees. While this organization might not prove lasting, yet while it was active it would so impress its members that they would ever after instinctively notice injured trees and give them proper care.

As an aid in making the pupils understand the nature of the danger which comes from hacking trees, a study should be made of the bracket fungi. These are more readily discovered as the leaves fall and, therefore, offer excellent subjects for study in November. There are many species of these fungi, three of which are very common. The bracket, gray above and with creamy surface below, (*Polyporus applanatus*), offers a tempting surface for the amateur etcher. Another species, (*P. lucidus*) is a beautiful

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mahogany color and *P. sulphureus* a sulphur yellow species is quite as common. While many of the shelf fungi live only on dead wood, there are several species which attack living trees and do great damage. Their spores enter the tree through a wound in the bark; and from the spores thus planted develops the mycelium, the fungus-threads which push directly into the heart of the wood, getting nourishment from it as they go. They push in radially and then grow upward and downward weakening the tree where it needs its strength to withstand the onslaught of the wind. Sometimes these threads grow into the cambium layer, which is the living ring encircling the tree trunk, and kill the tree. In any case, they are likely to shorten the life of the tree by many years.

After the fungus threads are thoroughly established in the tree, they again seek a wound in the protecting bark where they may push out and produce the fruiting organ, which we call the bracket. This bracket is at first very small and is composed of a layer of honeycomb cells opening below, cells so small that we can only see their openings with a lens. In each of these cells, spores are developed. Next year another layer of cells grows beneath this first bracket and extends out beyond it. Thus, each year an addition is made, so that the bracket grows thicker and its upper surface is marked with concentric rings around its point of attachment. Some of these bracket fungi reveal their age to us when we cut down through them and count the layers

When once the mycelium of such a fungus becomes established the life of its tree host is doomed and the lumber is made worthless. Sometimes a tree heals its wounds, and if there are no fresh bruises made, the fungus is imprisoned within and never produces a fruiting organ. However, its deadly work for the tree is accomplished.

As soon as a tree is bruised or cut, the wound should be painted or covered with a coat of tar. If the wind breaks a branch the splinters left hanging should be sawed off, leaving a smooth stump, and this should be painted. While ordinary paint if renewed each year will suffice, experiments show that a good coat of tar is a better protection.

This lesson should be given when a tree is found on which a shelf fungus is growing. The tree itself should be carefully studied, and then the fungus itself be made the subject of the lesson. The following are the topics for the children's observations:

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1. Is the tree on which the bracket fungus is growing alive or dead? Does it seem to be vigorous or dying?

2. Find the wound through which the fungus entered the tree and also the wound where the shelf grows out.

3. Examine the place where the fungus joined the tree and note if it seems to be a part of the wood. Cut back into the tree behind the fungus and note the condition of the wood.

4. Of what use to the tree is its heart wood? If the fungus weakens this, how is the tree injured?

5. Study the bracket above and below. Describe its upper surface. Are there concentric rings? If so, how are they produced?

6. Examine the lower surface with a lens. Cut the fungus and note that each hole in its lower surface is the opening of a tube. Do you find any "dust" in these tubes? If so, these are the spores which the wind sifts everywhere through the forest until some of them find a wounded tree in which to plant themselves. Cut down through the fungus and note if you can count the layers. Tell the age of the fungus by these layers

7. Write an English theme upon the proper treatment of trees for protecting them from the attacks of the shelf fungi.

The Present Status of Nature-Study in the Elementary Schools

ALICE JEAN PATTERSON

It is now about twenty-five years since the term Nature-Study was applied to a study of natural objects, as carried on in two or three schools. Since that time it has found a place in the curriculum of a number of our elementary schools. A glimpse at its history shows that it has had many ups and downs. On the one hand, it has been called a fad, mere sentiment, diluted science, and on the other hand one of the most valuable subjects in the entire school curriculum. It is not strange that it should have met with such diverse valuations. As a new subject it had to have its struggle with existing conditions, with tradition, conservatism and the misinterpretation on the part of teachers of what it really stood for in the minds of its promoters.

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To those of us who are vitally interested in nature-study as a school subject, the question comes whether or not it has found in our schools a niche that has been waiting for it since the time of Rousseau Pestalozzi and Agassiz. Is it fulfilling a definite mission, a mission peculiar to itself so that if it should be omitted from the list of school subjects, our children would meet with an irreparable loss? What is its present status as to purpose, content, and method in the schools of the country? To answer all of these questions intelligently, would require data obtained from actual visits made to schools in various parts of the country. Such is not forthcoming at the present time. However, the last question may be answered somewhat satisfactorily by a careful examination of the courses of study used in the elementary schools.

About a year ago, I attempted some such study and while I realize that it is far from complete, nevertheless it contains some facts that may be of interest to the readers of the NATURE-STUDY REVIEW. Later, I may be able to offer some data gathered from seeing children at work in nature-study classes. For the investigation I selected twenty state courses of study and those of thirty large cities. The courses were grouped to represent the four different geographical regions of the country, the east, south, middle west, and northwest including the Pacific states.

The first point under consideration was to determine to what extent there is unity of aim and purpose as indicated by the prefatory notes of the various courses. I quote from several, "The purpose of nature-study is first of all to develop in the child an interest in the things around him. When his interest has been aroused the outside world becomes to him an everpresent teacher. While it is true the material of nature-study is the foundation for later science work, it should not be taken up as a science study. We should use the material primarily to develop the powers of the child." "The primary object of nature-study is to train and cultivate the interest and enthusiasm of the child in natural objects and to develop an intelligent appreciation of the things in nature."

"The first reason for the incorporation of nature-study is to widen children's intelligent interest in nature objects and processes; the second to train the children in a scientific attitude of mind." "The work should be so conducted as to inspire the children with a love of the beautiful and with a sympathy for all living things. It should train children to investigate carefully and to make clear, truthful statements."

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"One of the chief objects of nature-study is to train the observation of children. It will increase the child's powers of expression and train him to walk with open eyes." "Its purpose is to aid in building up the child's mind by direct observation of the common things in the child's environment. The child must have rich, abundant, individual experience before it can come to a knowledge of its inheritance, the race experience"

It is useless to mulitiply citations. It is evident from the few selected at random that there is considerable uniformity of purpose in the minds of those who have planned the various nature-study courses for the elementary schools of our country

The second point considered was the material suggested in the different courses. Here again there is a striking similarity. plants, animals, weather phenomena and sky, physics and chemistry, including soil are represented in all of the courses. Plants and animals constitute the major portion of the courses. On an average 38.2 per cent. of the topics in the courses examined are based upon plant life; 34.4 per cent. on animals, and the remainder about equally divided between sky and weather, and physical and chemical phenomena. Plant topics arranged in the order of the greatest number of times that they appear are as follows: Trees, seeds and fruits, wild flowers, weeds, garden plants, farm crops, fungous diseases, bacteria, weeds, plant structures, and classification.

The chief animal topics are as follows: Pets, birds, farm animals, insects, wild animals, toads and frogs, fish, reptiles, poultry, earthworms, dairying, structure and needs of animals The favorite topics under weather and sky are:—the keeping of simple weather records, rainfall, winds, weather maps, movements of sun and moon. Identification of a few stars and constellations.

Topics based upon physics and chemistry are related largely to the home or agriculture. Simple physics of the soil appears in all but two of the State courses. Other topics are: vaporization and condensation, heat, light, air, electricity, machinery. sound, combustion, elements and compounds, acids, salts and alkalies.

The city courses show about the same per cent. of biological material as those of the state. A few of them, however, in the upper grades give considerable attention to experiments in pure physics and chemistry.

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The state courses with but few exceptions, group the matter all under two headings The work of the six lower grades is called Nature-Study, while that of the seventh and eighth grades is termed Agriculture. One state calls the entire course Agriculture altho the material is essentially the same as that of the other states. Some make the division at the fifth grade, calling the work of the four upper grades Agriculture. Several advocate the use of a text book in the grammar grades.

The method of presenting the work in nature-study is not easy to determine from a mere outline. However, the content of the courses as well as statements in the prefatory notes, give one a fairly good notion of the plan of attack that the authors of the courses have in mind. One states: "The teachers should bear in mind that the pupils in this work are discoverers, and should place them in such relation to the subject as to make their investigation profitable." Another says: "The teacher must have a strong conviction that nature-study if it fulfills its mission, must bring children into actual touch with real things." A third states: "The best teaching consists of the minimum of instruction by the teacher and of the maximum of study and inference by the pupils." A fourth statement: "Progress and results will depend not so much on the topics as on the method of presentation and treatment. This should be such as will enable the pupil to gain not only a sympathetic interest and knowledge of the phenomena of nature, but also an understanding of their fundamental association with life, in other words, of their economic values." Books form no part of this study. The child here must get sense contact of the world around it through the eye, ear, touch and smell."

Observation and handling of material are emphasized throughout the courses. The field excursion, observation of objects at home and on the way to school, and encouraging the children to bring in interesting objects, are suggested in more than ninety per cent. of the courses.

Muscular activities of children as related to the nature-study are given prominent recognition. The field excursion has already been mentioned. The care of pets is suggested in sixty per cent. of the courses. Fish and larvæ of water insects in aquaria, insects in terraria, pet toads, cats and dogs, canaries, and pigeons are all named as interesting pets to have in the school rooms for the lower grades.

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Seventy-five per cent. of the outlines suggest the making of collection of various kinds. Some of the most common are—seed charts, leaf charts, pictures of farm animals, collection of nuts, pebbles, weed seeds, grains of the community, and seeds of flowering plants and vegetables.

Forty per cent. advocate the training of the creative powers of children in the making of articles in connection with their nature-study such as, a doll house, in the lower grades, a farm house or barn in the intermediate grades, scrap books; making candy, butter, cheese, maple sugar, and simple pieces of apparatus as electric door bells and pumps.

Over ninety per cent. suggest garden work with a number of allied activities, as the germination of seeds, making cuttings, budding, spraying, corn gathering and judging, and planning and arranging a garden display.

The suggestion for correlating the nature-study and elementary agriculture with other school subjects is interesting. The most frequent correlation is with language. Eighty five per cent. of the courses studied suggest this correlation. The majority of these would have the teachers use the material of the nature-study lessons as the basis for a portion of the language work, both oral and written. A few, however, instead of having a course in nature-study suggest in the language course some nature topics that may be studied with profit as a basis for compositions.

Sixty per cent. of the courses suggest that the drawing be correlated with the nature objects under consideration in the nature classes. Many of the drawing courses, base their work largely upon nature objects without any special cöoperation with the work in nature-study.

About twenty-five per cent. suggest some correlation with geography. Several states and cities have a course called nature-study and geography. All of these that I examined treat nature-study topics in the first two or three years, then the work slips off into pure geography for the rest of the grades. About twenty-five per cent. of the courses suggest some correlation with human physiology, hygiene and sanitation. Three of the states have incorporated the hygiene and sanitation in the body of the nature-study course.

Domestic science and manual training are suggested as worthy of correlation in a few of the courses. About the same number

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show that arithmetic and reading may be in part consistently correlated with nature-study topics.

Summary: 1. The above meager investigation shows that nature-study is recognized as a school subject in both state and city courses in all parts of the country.

2. There is considerable unity of purpose in the courses offered by the various states and cities, namely, to bring children into intelligent, sympathetic touch with daily life, and to train them in a scientific attitude of mind.

3. The material suggested is that found in the environment of the schools. The biological phase receives greatest emphasis. State courses give a decided agricultural trend to the work of the grammar grades.

4. Gardening, making collections, setting up apparatus and other hand work constitutes a fair proportion of the courses.

5. Definite correlation with other school subjects is suggested in the majority of the outlines.

The outlook gained by the examination of the courses of study is very encouraging. It seems evident that nature-study is finding its place in our schools, a place that the formal, conventional subjects can never fill. It is true that we are not certain that all the lines of work suggested are worth while. It is also true that there will probably be some shifting of topics when we have learned by careful tests what best fits the needs of children at different periods of their development. But those things time and study will enable us to adjust. Our greatest concern now is that the teachers who teach the children will realize that nature-study *is different from the other formal school subject*, that they will appreciate the fact that children may be free and individual in the work and yet gain definite, practical knowledge; that they will have a strong conviction that the work properly taught will help the children not only to see understandingly, and to think clearly and accurately, not only to dig and hoe and plant but to appreciate law and order, to find beauty and truth in the daily common places, and a never ending joy in the great out-of-doors.

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Learning Disease Prevention in School. The House Fly as a Practical Lesson

C. F. Hodge, Ph.D.

Read at the International Congress on School Hygiene, Buffalo, Aug. 25, 1913

One sharp, vital lesson may leaven the whole lump of a child's life. Such a lesson may do more. It may work its way into the home and transform its attitude, and then continue to "work" like yeast of leaven in the life of the community and the world.

The modern problem of health conservation and disease prevention is based on really simple grounds of common-sense, cleanliness. Avoidance of contact with filth-infections and effective protection of food and drink from such contacts is almost the whole solution; and keeping the air pure by preventing infective matters from becoming dry and being taken up as dust is practically the remaining factor. Dangers from bites of mosquitoes, fleas, stable flies, and rabid animals may be easily taught when of local importance in the spread of disease, but need not be considered in this brief discussion.

Our problem is, that, of preventing the contact of persons, foods, and utensils with disease germs commonly found in waste matters or fifth, the problem of really common-sense cleanliness. The fact that such matters as quarantine and isolation, disinfection and proper disposal of human and barnyard wastes are not well understood indicates that we need to vitalize ideas on these subjects. This is one of the fundamental needs of our home and community life. It is a surprise to most people to realize that flies may break a small-pox quarantine.

At the time I was shocked and surprised to hear Dr. Charles Wardell Stiles say in a public lecture: *We are the filthiest people on the face of the earth.* Full and free confession is good for the soul, and, as I remember it, Stiles repeated the statement three times with all the emphasis he could give it. I have been thinking of it ever since and wish every man, woman and school child might do likewise until we become the cleanliest people on the face of the earth.

As I thought, I remembered the smooth, clean streets of Berlin, Leipzig, Dresden, Munich, Vienna, Milan, Paris, and compared them with the filthy streets of our own cities, paved with cobbles and riprap, the work unscientific and hap-hazard, the streets

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impossible to clean. But if you think that we do keep our streets and front yards possibly decent, how about many of the alleys and back yards? If you doubt Stiles word, work through the back alleys of any American city, except Cleveland, the present season. Here is where you will find the filth that goes half way toward accounting for our summer filth-mortality statistics. If we go to our farm barnyards we shall find much that accounts for the other half. I once heard a Scotchman remark that in his country a farmer would be prosecuted for criminal waste if he failed to keep his stables better than most of them are kept with us. Another Scotchman happened to tell me that a relative of his, on buying a Wisconsin farm was obliged to haul out four hundred loads before he could even begin to use the barn, and even then he was in danger of finding places in the yard where he was likely to get in over his rubber boots.

The state of health on a farm of this type is reported in the Indiana State Board of Health Bulletin for July, 1910. In response to an emergency call for Flexner's antimeningitis serum Dr. Simons finds a seven month's baby suffering from severe enteritis, with the accompanying meningism. A family history chart on the wall shows that four other babies have died under two years of age. He remarks the condition of the barnyard, saying, "If this farmer had attempted so unthinkable a thing as transforming his premises into a fly hatchery for commercial purposes, he could not possibly have achieved a more brilliant success." With the death of this baby the parents have lost five out of six children, and even this may be but a small part of the whole story. The farmer may have been producing milk or other dairy supplies, and for years have been scattering filth-fly funerals among the people of a near-by town or city.

Here, then, we have our vital lesson. Flies carry all means of infections to which they have access straight from filth to food. While effecting direct-contact infection the work of flies resembles air-borne contagions, baffling, impossible to trace, prevent or control. As this fact is being recognized health authorities everywhere are saying "Free the air of these universal distributers of filth infections in order that we may see to trace other channels by which diseases are spread." Hence fly extermination becomes the necessary first step in health conservation.

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In order to be vital the lessons must be real and to the point. After arousing general interest by telling the class what flies do; how in the Spanish war they wounded 20.788 of our soldiers, and killed 1,380, with the germs of typhoid fever, how they kill 58,000 yearly with the germs of enteritis, dysentery, fly-time summer complaint, almost all infants under two years of age, using tactfully any local epidemics or cases that may suggest a lesson, develop and draw out all the children know and finally call for volunteers to go into the barnyards (or old straw stacks in case of the stable fly) and get specimens of eggs. maggots and puparia, and with the filth in which they are found, demonstrate the whole life history of the insect. One teacher who did this writes:

"Last week I had some maggots in horse manure. It was an unusual thing to do in school, but I wished to emphasize the idea of filth. I think it was successful, for the disgust was great when they saw that they changed into flies. Poeple are so irresponsible that they have to be shocked to awaken their fighting power." (This can all be done in a cleanly and safe manner by putting the material into large fruit jars or wide mouthed bottles. Do not fill more than half full. If it is desired to keep them for several days to show actual development, they may require opening to give air once or twice daily, but they must be stoppered or closed tightly as maggots are strong and can burrow or squeeze through minute cracks) in concluding some of these experiments treat the material with a solution of iron sulphate, two pounds to the gallon, or with other substances recommended locally for killing the maggots about stables or outhouses).

Study with the class all the substances in which flies may breed, wet decaying matter, animal or vegetable, filth of stables, rotting lawn clippings, weeds or garbage, and work out practical methods for each home of dealing with all such substances to prevent flies from breeding in them. All such matters about the farm barnyard should be spread on the ground or plowed or harrowed into it daily. In this way, according to all recent investigations from 50% to 70% of its fertilizer value can be saved to the soil, which is lost by filthy, antiquated methods of storing and rotting. Even in the town or city lot, by proper planning, large quantities of stable refuse can be dug into the ground about trees, shrubbery or grape vines, between rows of bush fruits, strawberries or corn, while these are being cultivated or cleared of weeds. When properly spread or stirred into the surface it will become too dry

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and the bacteria of the soil will disintegrate the material too rapidly for maggots to develop in it. Thus, these lessons on the fly may not only influence the daily cleanliness of the home, but may effect the saving to garden and field of many millions of dollars worth of soil fertility now annually wasted.

The outcome of this work should be the steadfast determination of every member of the community that no pile of rotting filth shall be permitted to endanger the health or life of a baby.

Many cities and towns have already done so, and all must, the sooner the better, pass ordinances and develop plans for removal of all fly-breeding filth at least once a week during warm weather. Here the school children can aid greatly in spreading the knowledge and in developing sentiment in the homes for careful observance of such regulations. Several cities print the fly lessons on leaflets and distribute freely to the children in order to give them something authoritative to carry into their homes. Dr. Jean Dawson's leaflet in Cleveland has probably, more than any other one thing, influenced public sentiment to support the work in that city.

Ordinary house or typhoid flies, have been reared from maggots found in the snuff of a druggist's counter. This means that as long as there are flies around, they will succeed in finding something in which to lay their eggs. We must, therefore, attack the problem from both sides. We need to work for clean cities, towns, farms, and homes for many other reasons. The flies indicate the lines on which the general cleaning up must be done and constitute the sharp point of the wedge which must start things moving.

If the rate at which flies multiply were taught clearly in every school, to every boy and girl, the rest would be easy. A pair of flies may produce from 120 to 150 eggs at a laying and may live to lay at least six batches at intervals of eight to ten days. These eggs become adult flies in about ten days and are ready to lay the first batch of eggs when from ten to fourteen days old. If we start out with a pair of flies May 1st, how many will we have, if all were to live by August 1st? (allowing 150 eggs at a batch, six layings to a pair, and each pair beginning to lay when ten days old). Have the pupils work this out independently and see how near right the following figures are:

May 1 we begin with.....	2 flies
June 1 we have	117,702 flies
July 1 we have	6,484,702 flies
Aug. 1 we have.....	5,748,870,600 flies

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This last figure would mean about 148,875 bushels of flies. Any pupil who is fond of figures may continue the breeding through August and September. One who has done this in World's Work, May, 1912, gives us as the theoretical increase of a pair of flies in a season: 1,096,181,249,310,720,000,000,000,000 flies.

Very few flies live through the winter, in at least the larger part of the country, and if everyone realized how many might come from a single fertile fly not one would live to lay her first batch of eggs in the spring. They emerge from winter quarters desperately hungry, and with modern out-door traps set at this time over every garbage can and swill barrel, practical extermination would be complete by the first of June at latest.

This is not the place for details or information. Within the past two years plenty of out-door fly traps have been designed and they are on the market, and in many places the pupils are making traps after their own designs in manual training departments. Box traps for stable windows catch flies literally by the bushel, and with no trouble and trifling extense, make it possible to completely rid dairies and farm yards by halting the breeders before they can begin to lay. This is effective prevention, and here is the fallacy of those who would limit the work of prevention to cleaning up the filth in which flies breed. Which is easier and better to kill a thousand maggots in a cart load of manure or let the fly walk into a trap, before she begins to lay, and have her around for three months busy carrying filth to food while she is producing the eggs?

The final lesson which is well fitted for special emphasis in high school classes in biology, relates to need of perfect civic coöperation. The ignorant or careless household can breed flies enough to vitiate the best efforts of the rest of the community. There must be no ignorant or careless people in such vital matters. After having each member of the class actually work out a plan which shall render all fly feeding or breeding impossible about his own home. go a step further and ask each one to sketch a plan which shall be good enough to enlist every family in the community in this work. Discuss, compare and revise plans until one is agreed upon as good enough to submit to the community, then get it printed in full in the local paper. Many towns and cities have made and tried such plans and these are readily available in the literature. The one feature to be avoided is the offering of prizes or prices for the greatest number of flies killed during any season in which they may be

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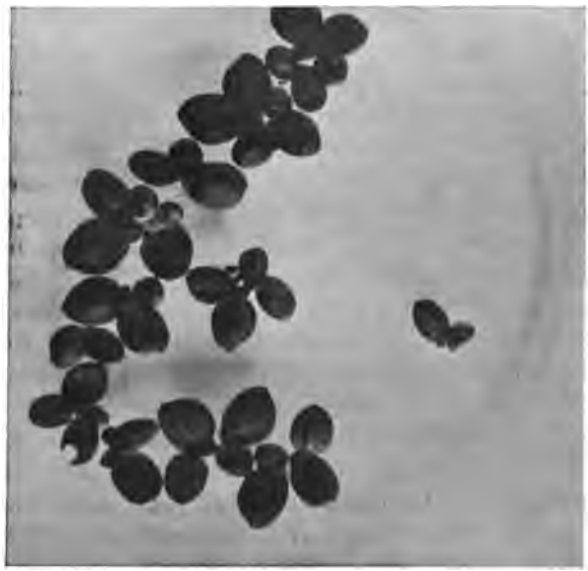
bred. A fortune might be made raising flies at ten cents a quart. All honors or prizes should be given for the less rather than for the more, for complete flylessness of a home, block, or section of a city.

In case such work has been done effectively, study carefully the vital statistics of the city and try to estimate fairly how much, disease and mortality has been decreased by riddance from this plague.

Under plans suggested and now in the field, I have seen homes so free from flies that screen doors and windows were not needed and while I have yet to see an absolutely flyless city, I have spent the past week in a residence section of Cleveland and I did not see one single typhoid fly in or outside of the house the entire week.

There can be no doubt that these lessons are leavening and vitalizing the whole lump of our home, community and national life. With the progress of the past three years kept up and increased, as all good movements tend to do, we may hope to see a flyless country within the next ten years, and then we may be the cleanliest, healthiest and most completely civic, civilized and decent people on the face of the earth.



Duckweed (Spirodela polyrhiza)
The growth from a single plant in twelve days. Photo and culture by L. S. Hawkins. Note the grouping in pairs, with small lobes forming between the larger old ones of the dividing individuals.

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A Field Lesson on Pasture Plants

JAMES G. NEEDHAM

Before there were tilled fields there were green pastures. The grazing animals made them. They cropped the tall vegetation and trampled the succulent herbage, and pasture grasses sprang up and flourished in their stead. Wherever there were pieces of level ground frequented by wild cattle, there pastures developed.

Pasture plants have seeds that are readily carried about and distributed by the muddy feet of cattle. They also have good staying qualities: once rooted in the soil, they will live long even where they can grow but little. So we find them growing everywhere, flourishing in the light, hanging on in the shadow, as if waiting for a chance—even in the deep shadow of the woods. Cut down the trees, and the grasses appear. Keep all the taller plants cut down, and the grasses spread and form a meadow. Brush-covered hills are sometimes changed into pastures simply by cutting them clean and turning in sheep. More sheep are kept on them than can find good forage; so, they are reduced to eating every green thing. It is hard on the sheep, but the grasses, relieved of the competition of the taller plants, spread in spite of very close cropping. After two or three seasons, the hills are turf-covered: the woody plants are gone. This is a crude method of pasture making, and one that is coming to be practiced in our day more often with goats than with sheep, goats having a wider range of diet: but it illustrates some fundamental condi-

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tions. Keep almost any weed patch mown, and it soon will be grass-covered.

The valuable pasture plants are all low-growing perennials, that spread over or through the soil and take root widely, and that are uninjured by the removal of their tops. Wherefore an amount of browzing and trampling that is sufficient to destroy their competitors, leaves them uninjured and in possession of the soil. We raise some of these pasture grasses on our lawns. We crop them with a lawn mower to make them spread, and we compress the soil about them with a heavy roller, and a turf results. But these operations are performed in nature by means of muzzles and hoofs.

If you would understand the conditions pasture plants have to meet, you can hardly do better than to cultivate friendly relations with some gentle old cow, and follow her awhile about the pasture watching the action of her muzzle and hoofs. Watch her crop the grass. See how she closes on it, and swings forward and upward, drawing it taut across the edges of her incisors, (these being in her lower jaw). Hear the grass break at the joints, and tear and squeak as internodes are withdrawn from their sheaths. Then pull some grass by hand, and observe that while single leaves may break anywhere, the stems for the most part break at the joints, which are so formed that little injury to the plant results. The parts necessary for re-growth remain attached to the soil and uninjured. Then try the tops of any common garden weeds, and observe that, for the most part, they pull bodily out of the ground. Herein appears one of the characteristics of good pasture-plants: they must be able to withstand cropping—even, close cropping.

Then watch the old cow's hoofs as she walks about over the turf. See how they spread when she steps in a soft place. Look at her tracks and see how the sharp edge of her hoofs have divided the turf and spread the roots and underground

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stems of the grass asunder. If broken, take up the pieces and observe that each is provided with its own roots. Thus, a moderate amount of trampling only serves to push the grasses into new territory. Think, how disastrous in comparison would be the descent of this bovine's hoofs upon the balsams and cabbages of the garden.

FIG. 30. The wire rush (*Juncus tenuis*).

So, the chief perils to plants in the pasture are of three sorts. The danger of death from being eaten, from being pulled up and from being trampled. To be sure, both browsing and trampling may easily be overdone, and the hardiest of plants may be exterminated. This occurs in the places where the herds habitually stand in the shade of trees. Furthermore, mere hardiness will not qualify a plant to be a good member of the pasture society. The first requisite of all is that it shall be palatable and nutritious. The little wire rush (Fig. 30) is among the hardiest of pasture plants, growing habitually in the very edges of the path, but it is worthless as forage.

The most valuable plants for permanent pastures are all grasses. Indeed, the very best of them are native grasses that exist today just as they came to us from the hand of nature. The only selection that has been practiced on them is the natural selection that through long ages has eliminated such sorts as are not equipped to meet the requirements set.

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Under certain conditions white clover and some other plants are useful members of permanent sod.

There are many other plants in the pasture, considered by us undesirable there, and hence called weeds. They mostly produce abundant seed and have excellent means of giving it wide dispersal. Many seeds find openings among the grasses.

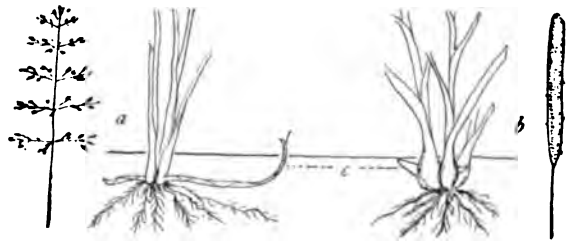

FIG. 31. Blue grass (*a*) and timothy (*b*): flowering spikes and roots; with the two modes of producing new shoots underground shown at (*c*).

A few of these plants survive by virtue of the same qualities that save the grasses Some like the thistles and the teasel are spiny, and able to ward off destroyers. Many, like the mullein, the buttercup, the daisy, and the yarrow are unpalatable and are not sought by the cattle. Many grow well underground with only their leaves exposed to danger of trampling. If some leaves are cut off new ones are promptly grow. Then, after a long season of growth, they suddenly shoot up flower stalks into the air, and quickly mature fruit. They do this, too, at the season of abundant grasses, when their exposed shoots are least endangered by close cropping. Some, like the dandelions and the plantains, produce so many flower stalks, they can survive the loss of some of them. Finally there are some, like the speedwells and the chickweeds so small they are inconsequential. They merely fill the chinks between the others.

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There is one tree that regularly invades our neglected pastures. It is the hawthorn. The cattle browse on it, but they leave a remnant of new growth every year. So its increase is very slow until it gets beyond their reach: slow but sure. All the while its dense cone of stubs is shaped smoothly as in a lathe. But once emancipated from their browsing, it suddenly expands upward into the normal form of the reading hawthorn tree.

Study 6. Pasture Plants

Any old pasture will do for this: the more neglected, the more interesting its population is likely to be. The equipment needed is merely something to dig with. Let all the work be done individually.

The program of work will consist in digging up one by one, first the forage plants and then the weeds, and examining them, root and branch. Give special study to the forage plants—the grasses and the clovers. Dig them up and pull them up. Find their predetermined breaking points. Observe their mode of spreading through the soil. Trample them, especially with the heels of your shoes. Observe their preparedness for the rooting of dismembered parts. Observe in the weeds also their various ways of preventing being pulled up or eaten up and trampled out of existence. Also stake out a square yard of typical pasture and take a census of its plant population.

The record of this study will consist in:

1. Annotated lists of:
   (a) Forage plants.
   (b) Weeds (further classified if desired), with indications, of size, duration (whether annual, biennial, or perennial) mode of seed dispersal (whether by wind or water or carried by animals on their feet or in their wool). Vegetative

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modes of increase, such as stolons, runners, offsets, suckers, etc., noting also special fitness for pasture conditions, as indicated above.

2. Diagram a vertical section of the soil and on it show form and growth-habit of half a dozen of the more typical pasture plants, such as the following:

(a) A grass that spreads by underground branches, like a bluegrass.
(b) A bulbous grass, like timothy.
(c) A creeping plant, rooting along the branches, like white clover.
(d) A rosette forming, tall, single-stemmed biennial like teasel or dock.
(e) A rosette forming, tap-rooted dwarf, like dandelion.
(f) A fibrous rooted perennial, like the daisy, or buttercup, or yarrow.

3. A complete census of the plant population of a single square yard of old pasture: names of plants and numbers of individuals. It will be necessary to state how you have counted individuals of the multiple-rooted forms.*

*The foregoing is a sample lesson from Professor Needham's field course on the Natural History of the Farm now being given to freshmen in Cornell University. It assumes an instructor who knows the plants, and a full equipment of stout digging tools in the hands of the members of the class. It illustrates record-making of three of the sorts that were discussed by Professor Needham in our last issue.—EDITOR.

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Will School-Gardening Survive?

H. M. Benedict

Professor of Botany and Head of Biology Dept., University of Cincinnati

(Address given before the School-Gardening Association of America, December 31, 1912, at Cleveland, Ohio.)

The insertion of another subject into the crowded mental menu of the schools is inexcusable unless the new subject unquestionably serves a purpose which the present ones do not. Is, then, the introduction of gardening worth while to the *child?*

I take it that our presence here indicates our emphatic belief that it is worth while.

Having accomplished its introduction, do we wish it to remain a permanent part of child training?

I hope that this is the earnest desire of everyone connected with this movement and I particularly pray that each one of us has looked far enough into the future to realize that the introduction of school-gardening will be shortly followed by its extinction if the gardens do not show the promised results.

What is the menace to its survival which we should foresee and prepare to combat?

Let us look at something not so close to our hearts as this school-garden movement, let us turn to something far enough away to present a true perspective and to permit of an unbiased judgment.

When a lad I visited the region between the rich farming belt of the Missouri valley and the semi-arid sage brush plains adjoining the Rocky mountains. This mid-region was an inland empire of millions of acres of fertile soil, warmed by the bright western sunlight and watered by rains. It possessed the natural qualifications required for human habitation and prosperity. But at the time when I visited it, in every direction for literally hundreds of miles, stretched abandoned fields desolate with weeds, the farm houses, deserted, were toppling to decay and broken windmills could be seen afar, standing like gaunt spectres of disaster over graves of buried human hopes and ambitions.

A decade before an army of human families, inspired by the sight of the prosperous farms to the east and urged on by the unbridled enthusiasm of land agents had settled upon this land, to make from it each a home and a fortune. One by one they became bankrupt, and although some refused to give up until fronted with actual

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starvation, in the end they were all forced to abandon their farms and their homes, and penniless, to drift to other regions and start anew.

What was the cause of this calamity to a whole people? Was it through fault of the land itself? Not at all; this very region today supports a prosperous multitude. Was it through lack of energy? These men worked with desperation. Was it through lack of enthusiasm or faith in the country? Every one had staked his all on his belief in the land. Was it through lack of numbers or concerted effort? The advertising given it in advance by ignorant enthusiasts and interested agents had peopled every farm.

What then? Just one thing, lack of knowledge. Neither their energy nor their enthusiasm, nor their numbers, nor the inherent qualities of the land availed them in the least so long as they lacked the specific knowledge of what kinds of crops to plant and how to cultivate them.

And now comes the rising tide of garden-work for the child, just as a decade ago rose the nature-study wave. What is the peril which threatens it, which even now is in evidence?

If the Garden-movement had a voice it would cry aloud—"Save me from the enthusiast who cries 'plant, plant' but who knows not how to ensure the crop!"

It matters not how energetic, nor how enthusiastic, nor how numerous we may be, nor how inherently valuable gardening is for the child, we shall be forced to endure the humiliation of seeing it fail and the sorrow of seeing its opportunities withdrawn from children, if we do not provide that its introduction be under the guidance of those who have the specific detailed knowledge necessary to produce a satisfactory harvest.

The first step, therefore, in the safe development of the garden-movement is the obtaining of practically trained advisers for the child's garden, experts who are able to see to it, that the work of the child shall bring him a profitable return and not a disheartening failure.

The school-garden-movement takes two forms at present, the making of community gardens, where land is divided into adjacent plots, and home gardens where the child has his individual plot in his own yard. In Cincinnati both phases are being developed, but much the larger emphasis is now being placed upon the home garden. It is quite obvious that the successful progress of home

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garden making, requires higher technical skill on the part of the adviser than does the community garden, since the conditions of soil, moisture, shade and slope will differ in each plot. It is also evident that a system must be in operation which shall bring the garden experts into personal acquaintance with the children and their homes, not only in one but in all sections of the city, and furthermore provide constant coöperation between the various experts so that they will form an organized permanent force for the continual increase of home gardens year after year.

Three fundamental necessities, therefore, must be met by a successful system for the development of the home garden movement in cities: obtaining garden experts; bringing these experts into contact with the children in their homes; welding them into a permanent coherent effective organization for the continuous increase of home gardens, a definite factor added to the life of the city for the years to come.

Cincinnati has originated a system which it is believed meets each of these requirements successfully. Essentially it is a coöperative relation established between the Department of Botany of the University of Cincinnati, and the public school authorities.

The splendidly organized city school system, with its grade schools lcoated in every part of the city, each with its corps of teachers in daily contact with the children from the neighboring homes, admirably fulfils the requirements of contact with children in all parts of the city. If some or all of these teachers, therefore, can receive special training and then bring this technical training to the service of the homes of the children in their respective schools, the first and second fundamental requirements of the home garden movement will be met. The public school authorities bring about the service to the homes by agreeing to pay fifty cents per hour for such work, after school hours and during the summer, to those teachers who have received the necessary special training The Department of Botany of the University agrees to furnish the special technical training required This coöperative system had been put to the test long enough to indicate whether it is practical and its success justifies a more detailed statement of the procedure.

Those teachers whose natural inclination toward gardening, encouraged by the opportunity of additional salary, leads them to desire to become official garden-inspectors, apply for entrance to the special garden courses provided for them at the University.

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The school authorities examine the list to see that each grade school is represented, so far as the limited number which can be handled in the University garden and laboratories permit. Since more teachers have always applied than can be accommodated, those asked to postpone their training are the ones whose schools are already represented.

Three courses continuing throughout one university year are now required of all garden-inspectors. The basic course consists of practical training in plant propagation by seeds, cuttings and grafts, the preparation of window-boxes and potted plants, seed-testing, cold-frame and hot-bed management and the raising of an individual bed of flowers and vegetables. This course occupies three hours on Saturday morning throughout the year. The specific principles involved in this practical work are explained in another course, consisting of lectures, discussions, trips to green-houses and parks, and assigned readings. This course occupies one hour each Saturday morning, and its purpose is to give the inspectors a broad enough knowledge of applied plant physiology to enable them to determine upon investigating a given plot of ground, what kind of plants will thrive best upon it, and how they should be treated.

The third course is given on Tuesday afternoon from 4:00 to 5:00, throughout the year, and consists of lectures on the human associations connected with common cultivated plants; where each first grew wild, what nation began its cultivation, to what other countries it was carried by commerce and exploration, what new varieties have been produced, what their present value is to the human race and what folklore tales and religious associations have gradually become clustered about it. This information increases the personal interest which the child takes in these plants, giving his growing garden a new significance and importance.

At the end of the university year, the instructors in the gardening courses send to the superintendent of schools a list of those teachers whose work in the three courses has been satisfactory and who are thought to have the personal qualifications advisable for efficiency in garden inspecting. These receive an official appointment as garden-inspectors from the school authorities and at once begin their work. They visit the homes of the children of their own schools, talk with the children and their parents about window-box or garden possibilities and offer to advise and look after any plant-

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ing which is undertaken. If their offer is accepted the most careful investigation is made of the available plot and the varieties of plants, treatment of soil, and kind of cultivation required. Then during the growing season, frequent visits are made to see that everything is going all right. The inspectors do their very best to prevent that deadly menace to the garden movement, the garden which fails, and strive their utmost to help the child and the cause by bringing the child's work to a happy fruition.

As a result of the work of nineteen inspectors last summer, who by the way had only eight weeks of training instead of the forty weeks now required, and who were prevented from starting their work until nearly July, 1,522 home gardens were planted by children in all parts of Cincinnati, and over 80% of these were carried to a conclusion which delighted the young gardeners and brought a sigh of relief to the inspectors. The inspectors are, without exception enthusiastic over the results of the establishment of the garden to the child and to the home. Some of their experiences are touching evidences of the innate love of the child for growing things, a love which cannot be gratified in the lives of the great majority of the children of the cities until organized effort opens the way.

The inspectors are very anxious for further special training. Their experience has shown them that they would have been absolutely helpless without their preliminary training, and that the more they have the more efficient their work will be. This need has caused a number of them to take the long courses this year, although they have already been appointed inspectors. The enthusiasm of the experienced inspectors and their desire for further technical training points very clearly to the best way in which to meet the third fundamental requirement of the home-garden movement in cities, the welding of the inspectors into a permanent coherent organization, which shall cause home gardening to increase with gathering momentum. The way must be opened for official inspectors to take up advanced lines of work provided by the university through which their knowledge will be increased, their enthusiasm maintained and constant touch established with what is being done in other institutions and in other cities. Inspectors with these opportunities will form an organized body of very great influence in bettering the conditions of the children and homes and in beautifying all parts of Cincinnati, but its individual members will be in demand by other communities, to introduce and

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organize efficient systems of municipal home gardening. In other words the success of the present system will cause it to grow as naturally as a plant into a "school for school-gardening," whose undergraduates, the teachers taking the present courses and the new ones to be provided, will be serving the city with steadily increasing efficiency, while its graduates will be leaders in the school-garden-movement.

Our experience so far, has certainly shown the practical success of this system of coöperation between the Department of Botany and the school authorities in a striking manner, and it is believed that it represents the extreme of efficiency and offers a guarantee of the success of the school-garden movement.

The supporters of the school-garden movement cannot too often remind themselves that introduction of gardening is nothing, success of gardening is everything. We must try to avoid the perils so plainly indicated by the experience in other lines, and which are even now appearing in the garden-movement. The present introduction of compulsory agricultural education in this state, without making provision for enough trained teachers, is in fact a frightful example of this menace.

Whether school-gardening persists or disappears depends on one thing and that alone, the crop.

News and Notes

Report of the Spring Activities of the South Side Section of the Chicago Nature-Study Club

The annual meeting of this section was held in the Bowen High School, April 12, 1913. At this meeting the officers for the year were elected and plans for the spring excursions announced.

Beside the meetings for Bird-Study in Jackson Park every Thursday afternoon during April and May the section has enjoyed three very successful trips to neighboring localities for the study of flowers and trees.

The first of these trips, May 10th, to Fort Sheridan was attended by twenty-three members who most thoroughly enjoyed the walk down McCormack Glen to the Lake. White trilliums and violets were found in great abundance.

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Twenty-seven members participated in the second trip, May 17th. This excursion consisted of a delightful walk along Thorn Creek from Glenwood to Thornton. Wild crabapple blossoms furnished the chief attraction on this trip.

The last excursion for the spring term occurred on Decoration Day, May 30th, when forty-two members visited Tremont, Ind. This proved the most successful trip of the season. The lupines were at their best and the Sand Dunes never looked more beautiful.

We are pleased to be able to report an increase in the interest and membership of this section and hope it may continue during the fall term.

MR. W. WHITNEY, *State Chairman*

SUE J. REID, *Secretary.*

Miss Delia I. Griffin has recently accepted the curatorship of the Children's Museum of Boston. The museum was established for active work, July 1st, though the Science Teachers' Bureau which started it, having collected some exhibits a few months before. This Bureau also carried on field classes Saturday, for two seasons.

The annual meeting of the St. Louis Section was held Sept. 17, 1913, the attendance was good and much interest was shown in the work of the section. Field trips for the coming year were discussed. The following officers for 1913–1914 were elected:

President, Mr. L. M. Dougan, Shaw School; director, Mr. W. J. Stevens, Field School (holds over); secretary-treasurer, Miss E. C. Crecelius, Teachers College; members of the executive committee, Miss Ada Plass, Gardenville School; Mr. J. A. Durshel, Harris Teachers College.

Trusting our relations may be of the pleasantest, I am,

Respectfully yours,

ELYSE C. CRECELIUS,
Secretary and Treasurer.

Here are a couple of sets of Ohio examination questions in Elementary Agriculture:

1. Why should there be a legume in every rotation of crops?
2. Name two general ways by which we maintain soil fertility.
3. What is a cover crop? Of what value are cover crops to the soil, to the growth of fruit trees?

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4. Name some of the causes of injury to seed corn. Explain difference between a balanced ratio and nutritive ratio.

5. What effect has lime on the development of nitrogen fixing bacteria?

6. Name at least five effects of good drainage on soil and crops.

7. What do you understand by the following terms: capillary water; water table; percolation?

8. Indicate what you consider a good crop rotation for your community. Give reasons.

1. What is the soil? Sub-soil? Are earthworms a benefit or an injury to the soil? Why?

2. How do legumes help to keep up the land? What crop rotation is best for the land?

3. What do you understand you should do to girdle a tree? What would be the result?

4. Explain the principal features of tree pruning. When and how often should trees be pruned?

5. On what fruit does the codling-moth work? Where does the curculio lay her eggs? When?

6. Why is corn cut in shocks, when ripe? What would you consider a good crop of corn in bushels per acre?

7. What is a mulch? On what crops are chinch bugs found? How may these bugs be destroyed?

8. What birds are of greatest value to farmers?

At the Stepney nature-study museum many of the tanks are not artificially aerated, but are kept clear and sweet by the balance between the plant and the animal inmates. One tank established in 1909 was exhibited. The water has never been changed, nor has any form of plant or animal living or dead, been added or removed during the four years. A slight drawback to this type of aquarium is the difficulty of keeping large fishes, for in a balanced tank the plant life should be about one hundred times greater in bulk than the animal life; yet on the other hand, once such an aquarium becomes settled it remains perfectly clear, and swarming with ever-changing forms of life, for an indefinite period. No attention is required other than the occasional addition of water to make good the loss from evaporation during dry weather. As a rule, plants possessing stomata, and such vegetable-eating organ-

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isms as caddis grubs, are not very suitable inmates of a balanced aquarium.

The same institution also showed a number of models illustrating a simple and efficient method of making permanent preparations of fishes. By this process the fish is cast in wax and plaster, the original fins replaced, and the model painted to life from a fresh specimen.

The fins are first removed and stuck—by their own mucus—on a sheet of glass, where they soon dry in any desired position. The fish is then placed in a shallow trough, and covered entirely with melted paraffin wax, of the quality used for common wax candles. When the wax is quite cold and hard the fish is removed, and of course it leaves a perfect mould; this is filled with plaster of Paris in the ordinary way of casting. and when it is set the wax is cut or broken away.

The next step is to fix the dried fins in their proper positions on the plaster cast; but as plaster does not provide a good painting surface, the cast is "gilded" with aluminum leaf, which gives a clear metallic surface that takes ordinary artists' oil colors in an admirable way, and anyone practised in painting can soon bring the model to such a point that it cannot be told from a fresh fish unless by handling. When it is remembered that about one hundred different species of fish have been purchased lately from the shops and stalls in a single Stepney street, the elementary study of food fishes suggests a promising field for town children.—From *School Nature-Study*, London, Eng., June, 1913.

Nature Articles in October Magazines

American Magazine—The Village of a Thousand Souls, Arnold L. Gesell. A Study of heredity from first hand sources. The genetic condition of a typical western city.

Atlantic Monthly—A Hay-Barn Idyll. John Burroughs. An account of the birds that live about the barn.

The Garden Magazine—The Child's Garden, edited by Ellen Eddy Shaw, deals with bulb planting and culture.

Harper's Magazine—An Old Tow Path, Richard Le Galliene.

Outing—Wild Pets, Edward Breck. The young of wild animals learn things instinctively and do not need instruction by their parents.

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Outlook—Nature Month by Month, November, Ernest Ingersoll, Oct. 25. The Doings out-of-doors in this month.

Review of Reviews,—Hansen, America's First Plant Explorer. William J. Kirkwood. An account of the introduction of some hardy alfalfas into the United States.

World's Work—Forests of Usefulness, Henry S. Graves. An account of the conduct of the national forests.

Editorial

This is a period when educators are much concerned with the problem of moral education. Some of the forces that formerly made for high moral ideals have been eliminated from the school. In the community itself the rigorous methods of moral discipline that prevailed among the sturdy stock a generation ago, have disappeared. Children are reared perhaps as wisely, but certainly with much less insistence upon exact adherence to what were considered essential moral standards. We welcome therefore in the school and in all education, those things that tend to exert a distinctly moral influence. Nature-study, we believe, is one of these things.

There seems to be something in the mere familiarity with nature that imparts to the individual a sturdiness and integrity. Whether it is the recognition of the regularity of Nature, the certainty of effects that wins recognition for her laws, or whether it is a sympathy that stimulates ideals, it certainly seems true that the man who lives close to Nature is, perforce, a man of upright character. Seer, prophet and moral leader have always gone apart to the mountains and the hills and the secluded spots to renew their inspiration. Those nations which have lived among the fastnesses of the hills have always been hardy, independent and noble. So with the individual "One who has grown a long while in the sweat of laborious noons, and under the stars at night, a frequenter of hills and forests, an old honest countryman, has, in the end, a sense of communion with the powers of the universe, and amicable relations towards his God. His religion does not repose upon a choice of logic; it is the poetry of the man's existence, the philosophy of the history of his life."

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Book Review

The Story of My Boyhood and Youth, by John Muir. Houghton, Mifflin Co., 294 pages, price $2.00.

John Muir has long been known as one of our most appreciative nature writers. This story of his boyhood and youth is a valuable accession to our list of biographies of eminent naturalists, and it is an inspiring bit of personal history as well.

Born in Scotland, he early came to this country and settled in Wisconsin where his father had taken up a farm. He was sent to school before he was three years old, and even before this he had learned his letters from the shop signs. His recollections of these early school days are recollections of the stories of the readers. Along with the school lessons his father taught him hymns and bible verses. He well remembers earning a penny for learning "Rock of Ages." He was skilful in games and took part in all of the boyish sports; delighted in dog fights and went through the customary quota of boyish escapades. As a boy he knew the animal life of the sea, near which he lived, hunted birds' nests among the cliffs and through the meadows. "Kings may be blessed; we were glorious, we were free, school cares and scoldings, heart thrashings and flesh thrashings alike, were forgotten in the fullness of Nature's glad wildness. These were my first excursions, the beginnings of lifelong wanderings."

If the new world was full of delight for this boy who loved the out of doors, it was also full of toughening farm work, and moral instruction that was decisive and severe according to the good old Scotch notions. The Wisconsin farm was in those days a paradise for a nature lover and his description of his boyhood experiences is fascinating reading.

He was an inventive youngster and with his jack-knife made a clock for the household. He also manufactured a thermometer. "The scale was so large that the big black hand on the white painted dial could be seen distinctly and the temperature read while we were ploughing in the field below the house." It was some of his machines that won him entrance to the State University, where he remained for four years earning his way and boarding himself. He had a clock of his own manufacture rigged in his room so that at the proper time it started the mechanism that stood his bed upright and forced him to get up. He also had a desk

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which mechanically brought out the appropriate book at the proper time for study and opened it, and at the end of the time of allotted study, closed it and set it on the shelf, and the next one to be studied followed. Withal, the book is a fascinating tale of a productive boyhood that led on to a superb manhood.

Country Life and the Country School by Mabel Carney Pages XXIX+405, Row, Peterson & Company, Chicago. Price $1.25.

The author's preface opens as follows: "This book is for farmers and country teachers, written not about them but to them. It takes form as the direct outgrowth and personal need of eight years' work in country teaching and the training of country teachers " and it is a very excellent message that the book contains from an earnest and wise woman. If superlatives were not dangerous I should say it was the best book on the Rural School and its problems. It certainly is among the best.

Chapter one is on the Farm Problem and its Solution. We have constantly had the farm problem presented and it is refreshing to find someone confidently attacking its solution. Then come chapters on the farm home country church, the grange, farmers' institutes, roads, country life and the country school as an agency. It is not necessary to give further the chapter headings as this suffices to give the scope of the work.

In the appendix there is given the outline of a course in country school teaching for country teachers. Here is to be found a discussion of the building and its equipment, with the names of supply firms and prices of materials. Here, also are given the sources of illustrative material, of good literature, music, etc. There follows a directory of rural progress and a good bibliography.

Throughout the book one is impressed with the concreteness of the discussion. It is an account of what has been done, with detailed instructions as to how it was done, with facts and figures as to the results and careful statements of the expenses down to the last cent. If one is at all interested in the problem of the country he will read the book with as keen a relish as he would an exciting novel and lay it down with the conviction that the country school problem is meeting a very satisfactory solution.

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Beyond War, a chapter in the Natural History of Man. by Vernon L. Kellogg, 172 pages, Henry Holt & Co., New York, price $1.00.

This little book is a demonstration of the thesis that man in the course of his evolution must go on to a stage beyond war. The final words of the book are as follows: "And Man has a uniform motion in a straight line toward an evolutionary goal, of which War is an absolutely impossible part. The motion of Man is toward mutual aid, altruism. War is all that these are not. These are life conditions that oppose all War. The inertia of the evolutionary movement of Man will overcome the inertia of the lessening resistance to this movement. War is already an anachronism in the life of Homo sapiens. The evolutionary mode of the Blond race has moved beyond it. The leaders will fall into the mode or fall out of their places. Homo superioris will be, whatever else he is, *Beyond War*."

The book commends itself to all readers whether they agree with its conclusion or not, because it is a splendid statement of the evolution theory, especially as it applies to man. It traces his history from the earliest beginnings up through man of the Great Ice Age, the later man who used the polished stone tools, and then the metal instruments, and finally up to the man of dim historic times. Moreover, it is with a distinct Neo-Lamarckian tendency it is written the author believing that many of the changes in man's physical structure are induced by the influence of his changing environment.

Plant and Animal Children and How They Grow. Ellen Torelle, D. C. Heath & Company. $.50.

In this book the author has expressed in simple language the essential facts and principles of growth in plant and animal life. Its appearance is timely owing to the need for a text of this nature. At the Fourth International Congress on School Hygiene, recently held in Buffalo, scientists and educators agreed that the time had come when the attitude of the world's educational institutions toward sex hygiene should be revolutionized. This matter has been a subject of discussion in various educational and sociological gatherings for some time past and the opinion has steadily been strengthening that boys and girls in elementary grades should receive careful instruction in the hygiene of the human body.

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This book is written especially for pupils in the elementary schools and the ideas of evolution, heredity, variation, effect of environment and the evolution of sex have been so skillfully considered in their relation to plant and animal life that the pupil will acquire an intelligent understanding of natural development without being troubled with any of the above terms.

Teachers who have been at a loss to know how to approach this subject will find in this book a guide which will enable them to present such lessons in a satisfactory manner. Miss Torrelle has demonstrated in practical work in public schools, that children are greatly interested in the study of plant and animal life when it is related to human life and its problems. We would recommend this book to any teacher, parent or school board who wishes to teach a series of lessons on life phenomena that will be rational and comprehensive.

O. M. C.

Mouth Hygene and Mouth Sepsis. John S. Marshall, M.D., pp. XI + 262. J. B. Lippincott Co., Philadelphia. $1.50.

The author of this book was for a number of years a dental surgeon in the U. S. Army and probably has had the opportunity to make a study of a greater number of human mouths than has come to any other American. His sincerity, professional insight, and deep human interest are apparent on every page of his book. One cannot rise from the reading of it without a profounder conviction of the very great importance of oral hygiene, as a means of human conservatives.

Dr. Marshall quotes Dr. Osler as saying in an address to a group of dental students. "You have just one gospel to preach. It is the gospel of the cleanliness of the mouth; cleanliness of the teeth; cleanliness of the throat. These three things must be your text through life." This is the gospel that this book presents with evangelistic fervor. In consequence, it is open to the criticism of being too hortative in its style. It also abounds in descriptions of individual cases as illustrations, and in excessive quotation. One also feels that the attempt to be non-technical and at the same time to adhere to technical terms results in a treatment unsatisfactory both to the lay reader and to the dental technician. The print is large and the page rather narrow, so that the book can be read by the average reader in a few hours.

F. M. G.

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Stories of Childhood and Nature, by Elizabeth V. Brown, World Book Co , New York, pages 192. $.40.

Another of the nature and industry readers is "Stories of Chidhood and Nature." designed for supplementary work in the fifth and sixth grades. The stories are carefully selected and present much useful information in a style that will appeal strongly to children. Among the subjects treated are the cicada, starfish, tropical trees, ants, beetles, peanuts, cotton and childhood stories. Choice poems by some of our well-known authors add to the teaching value of the book.

It is printed in a clear, bold type and is nicely illustrated.

I believe the author has accomplished what she states to be the purpose of the book, "To open the door and let the children go out to the woods and fields and shore where countless things of interest invite and await them," and "to respond to the human interest of children."

B. B. K.

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VOL. 9 DECEMBER 1913. No. 9

Retrospect and Prospect

This year marks an important advance in the affairs of the American Nature-Study Society. The publication of our journal has heretofore devolved upon the secretary-editor who, at present at least, lays no claim to business sagacity. It has been one of his chief ambitions to bring the journal to such a point of excellence that some responsible publishing house would be willing to undertake its business management. That is now accomplished. No firm in this country is better equipped to successfully publish our REVIEW than the Comstock Publishing Co. The results already achieved indicate that the changed policy is a wise one and the outlook for the near-future is excellent. The Comstock Co., takes charge of the subscription list, solicits the advertising and pays the bills, all of which details the editor has heretofore assumed. Our readers are to get the benefit. The Company already reports good increase in the advertising space taken. They ask that the magazine be made of generous size. It has been increasing for several years. In 1909 it contained 253 pages; 1910, 281; 1911, 290; 1912, 348.

We shall start next month an exchange department which will be of undoubted service to our readers. The list of Nature-Study Articles in the current magazines will be a regular feature. Mrs. Comstock's articles on practical lessons in Nature-Study will continue to be monthly features. Mr. Needham will be a frequent contributor. Some articles will appear shortly on Nature Photography for Beginners. We have a series promised on the Stars as Nature-Study Objects. The editor will be very glad to receive suggestions from readers as to the sort of articles they would like to have appear.

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The "Office" has never been more enthusiastic over the prospects. We are assured of our most prosperous year in 1914. Please renew your subscriptions promptly. Pass the good news to your friends. Send in the names of those who may be induced to subscribe so they will receive sample copies. THE REVIEW is your magazine. Make its influence felt as widely as possible.

The Annual Election

The Council has made the nominations for the officers of the Society. They will be found on the ballot published in this number on the last page. Please cut this out, mark it as directed and mail it before December 24 to Elliot R. Downing, the University of Chicago, the School of Education, Chicago, Ill. Every subscriber to the REVIEW is entitled to vote. Show your interest by assisting in the election. Last year out of a membership of 1400, fifty-one voted. Indifference of this kind is not heartening. At least spend two cents and a moment's time to show your confidence in the present policy and your interest in the work of the society.

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Goldfish and Geography

ANNA BOTSFORD COMSTOCK

If we could be transported back in time and place to where the ancestors of the goldfish in our aquarium swim wild, it would be one of the most interesting journeys imaginable. For it might take us back into ancient China and along the streams which flow into those magnificent rivers which sweep over the high mountains in eastern China to the great rich plains of the coast. And we should pass strange cities beset with beautiful temples, and we should see Chinese men dressed in their robes of silk, the color of peach blossoms or apple blossoms, as blue as the sky or purple as the violets. And we should find, playing by the banks of the stream, little children dressed in every color of the rainbow, and the little girls might perhaps be toddling about on their tiny bandaged feet.

And if we should find this ancestral fish, we would find with it many companions in this picturesque stream, because the Chinese have been the best managers of fish in the world. We, in America, are thousands of years behind the Chinese in intelligence in the art of preserving fish. From times too ancient to be recorded in history, the Chinese have yearly taken loads of water in which there is a spawn of fish, and have carried and emptied them into safe ponds where the newly hatched fry could be fed, usually upon lentils or yolks of eggs. The result is that although China is over-populated, having at least three hundred persons to the square mile, yet the rivers of China are full of fish of all kinds, while we with our scant population of scarcely twenty people to the square mile have almost exhausted the supply of fish in our rivers and lakes.

And this ancestor of our goldfish in its native stream is not gold at all, but is olive-green above and yellow below, for a gold colored fish could not have lived very long,—it would have been swallowed by some wild duck, goose or swan, which occur in great numbers in Chinese streams; or a pelican would have gobbled it up in its great fish basket. Or a fish merling, which the Chinese train for catching fish for them just as we train dogs for game, would have captured our fish. But its safe green color saved it and its descendants were taken by the skilful Chinese and through much breeding and careful selection were changed in color to gold and silver. And if by chance, we raise goldfish in our aquaria we find when they are small they have dull colors like their old ancestors; and if our gold-

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fish in the ponds escape into the streams, by some helpful magic, they soon regain their safe, dull brownish-green color. Numbers of these fish are found in our rivers and the only way we know that they are goldfish is by their form, for we should never suspect it from their color.

While the Chinese originated the goldfish and developed it into many grotesque forms, it remained for the Japanese to develop from it fish of the most graceful form and the most delicate colors. There are ten well-marked varieties of Japanese goldfish, each with graceful flowing fins and colors that range from black and gold and silver to pale blue and green. Americans are always surprised to discover how large a part goldfish play in the lives of the Japanese people, especially of the children. It is estimated that in Japan, twenty million goldfish are sold each year at a value of half a million dollars. Even the humblest homes have their goldfish in little aquaria, while the wealthy have these brilliant little creatures in the ponds and fountains of their wonderful gardens.

Goldfish belong to the carp family, and are called by some "green carp." They may attain a length of eighteen inches. It is said that they may live to be a hundred years old, but probably this is an exaggeration. There are instances on record where specimens have been kept in an aquarium and in good condition from ten to sixteen years. The annual sale of goldfish in this country is estimated at two millions.

These ornamental fish, so easily kept in the school room, should be a link of interest, holding the child's mind to Oriental lands and streams. Moreover, no other fish so readily lends itself to the study of fish form as adapted to life in the water.

The first study of the fish should be its shape. Looked at from above, the broader part of the body is near the front end which is rounded or pointed so as to cut the water readily. The long, narrow, hind portion of the body with the tail acts as a propeller. Seen from the side, the body is a smooth, graceful oval and this form is especially adapted to move through the water swiftly.

Fishes need to push through water, which is more difficult than moving through air, so they need to have the body well protected. This protection is, in most fishes, in the form of an armor of scales which are smooth and allow the body to pass through the water with little friction. These scales overlap like shingles on a roof and are all directed backward. The study of the fishscale shows

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that it grows in layers. Extending along the sides of the body from head to tail is a line of modified scales containing small tubes connecting with nerves; this is called the "lateral line" and it is believed that it is in some way connected with the fish's senses, perhaps with the sense of hearing.

Normally, the fish has seven fins, one along the back, called the dorsal; one at the end of the tail, called the tail or caudal fin; one beneath the rear end of the body, called the anal; a pair on the lower side of the body, called the ventrals; and a pair just back of the gill openings, called the pectorals. All these fins play their own parts in the movements of the fish. The dorsal fin is usually higher in front than behind and can be lifted or shut down like a fan. This fin, when it is lifted, gives the fish greater height and it can be twisted to one side or the other and thus be made a factor in steering. The anal fin, on the lower side, acts in a similar manner. The tail fin is the propeller and sends the body forward by pressing backward on the water, first on one side and then on the other, being used like a scull. The tail fin varies in shape very much in different species. In the goldfish it is fanlike, with a deeply notched hind edge, but in some it is rounded or square.

The paired fins correspond anatomically to our arms and legs, the pectorals representing the arms, and the ventrals, the legs. Fins are made up of rays, as the bony rods are called which support the membrane; these rays are of two kinds, those which are soft, flexible, many jointed and usually branched at the tip; and those which are bony, not jointed and which are usually stiff spines. When the spines are present in a fin, they precede the soft rays.

In order to understand how the fish breathes, we must examine its gills. In front, just above the entrance to the gullet, are several bony ridges which bear two rows of pinkish fringes; these are the gill arches and the fringes are the gills. The gills are filled with tiny bloodvessels, and as the water passes over them, the impurities of the blood pass out through the thin skin of the gills and the life-giving oxygen passes in. Since fish cannot make use of air unless it is dissolved in water, it is very important that the water in the aquarium jar should often be replenished.

Lesson on a Goldfish

Before the pupils begin the study, place the diagram shown on the blackboard, with all the parts labelled.

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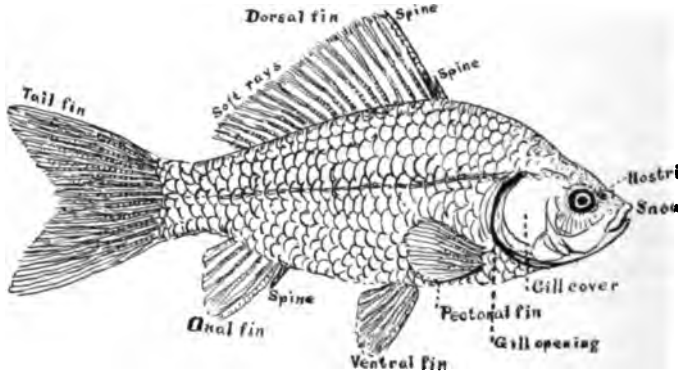

1. What is the shape of a fish when seen from above? Where is the widest part? What is its shape seen from the side? In how many ways is the shape of the fish adapted for moving through the water?

2. Study the covering of the fish. In which direction do the scales seem to overlap? Of what use to the fish are the scales? Note a line which extends from the upper part of the gill opening, along the side to the tail.

3. How many fins has the fish? Make sketch of the goldfish with all its fins and name them from the diagram on the blackboard.

4. Which pair corresponds to our arms? Which to our legs?

5. Describe the pectoral fins. How are they used? How do the ventral fins assist the fish when swimming? Study the dorsal fin. How many spines has it? How many soft rays are there in it?

6. Study the anal fin. Has it any spines in front? How many rays has it? How is this fin used when the fish is swimming?

7. With what fin does the fish push itself through the water? Note if the tail is square, rounded or notched at the end. Are the rays of the tail fin spiny or soft in character?

8. Watch the goldfish swim and describe the action of all the fins while it is in motion. In what position are the fins when the fish is at rest?

9. Note carefully the eyes of the fish. Can you see the nostrils? Describe the mouth of the fish.

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10. Is the mouth kept always in motion? Note a wide opening along the sides of the head behind the gill cover. Does the gill cover move with the movement of the mouth? How does a fish breathe?

Subjects for English themes or for recitation—Where do the goldfish naturally occur? Describe the Chinese rivers; describe how the Chinese have preserved fish in their streams; describe how and why the Chinese have changed the colors and form of the goldfish; how are goldfish esteemed and bred by the Japanese?

Natural Nesting Sites As a Factor in Bird Abundance

C. W. FINLEY

That our native wild birds are decreasing in numbers is generally conceded to be true but there is no consensus of opinion as to the dominant factor causing this decrease. The small boy with the gun, promiscuous egg collecting, hunters, cats, snakes, birds of prey, red squirrels, skunks, minks, weasels, migration fatalities, etc., are all important factors, no doubt, but another factor far more important than most of these is the removal and destruction of the natural nesting sites of many of our birds. Man in changing his environment takes little or no thought of the welfare of his feathered friends. As a result some of the birds have changed their nesting habits and have thus been well able to cope with the changing situation. Many, however, have not so changed their habits and have suffered as a consequence. This situation is well shown in the case of the prairie chicken, *Tympanuchus americanus americanus* (Reich.) in Illinois.

In the summer of 1910 a prairie chicken "survey" was made in this State under the auspices of the State Game Department. The survey was limited to an investigation in ten counties three of which, Coles, Moultrie, and Douglas are in the "Black Prairie Belt" of the State and the others, Effingham, Jasper, Clinton, Clay, Fayette, Marion, and Richland are in the clay prairie region. For eight years prior to the time of investigation the prairie chickens had been protected by a State law and it was the quest of the department to find whether there had been sufficient increase in numbers during this time to justify an "open season" on these birds.

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The plan was to make house-to-house interviews with farmers living in the prairie regions of the counties named. It was taken for granted that the farmers who had lived in any given locality for eight years would know most about the status of prairie chickens of that region, as to whether there had been any increase in numbers and the approximate number of them on his farm at the time of the interview. True to expectations they did know both things. Here are some verbatim remarks: "There are twenty-seven chickens that keep on my farm." "There are sixty-three in the flock on my farm, I have counted them many times." "I have four flocks, three of them have about twenty-five chickens in each and the big one about forty." "There are only six flocks in this whole community." The data was recorded during the interview. If the flock of chickens was reported to have fed on more than one farm, a proportionate number was recorded for the farm in question. A summary of the tabulation is as follows:

County	Acres represented in reports	Number of chickens reported	Average	
Coles	12346	530	1 to 24	acres.
Moultrie	777	31	1 to 25	"
Douglas	4125	141	1 to 30	"
Effingham	8704	2505	1 to 3½	"
Jasper	6513	1596	1 to 4	"
Clinton	3418	510	1 to 7	"
Clay	3277	500	1 to 6½	"
Fayette	3000	910	1 to 3½	"
Marion	2587	647	1 to 4	"
Richland	480	135	1 to 3⅓	"

It is thus seen that in the clay prairie counties the chickens averaged one to each four and one-half acres while in the three black prairie counties the average was one to each twenty-six and two-thirds acres. An analysis of the farming conditions and practices will throw some light on the matter.

In the three "black" counties land is worth from one hundred, fifty to three hundred dollars per acre. This high price stimulates intensive farming and the elimination of waste land. The border of a cultivated field is often less than two feet in width. Barely enough hay is raised to supply the needs of the farms. Hence, about the only place in which a nest might pass the incubating season successfully is the narrow border mentioned above. The only nest reported in the three counties which was actually known to have eggs which hatched was in such a location.

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In the clay counties quite a different condition of affairs obtains. The soil is hardly half as valuable. Much of it is too compact to be successfully drained by tile, and open ditches result. These ditches are skirted on each side by patches of "blue stemmed" prairie grass. The fence rows are as a rule very wide and are filled with the same grass. One public highway, little used, was completely covered with this same plant. From one point, eighty-five hay-stacks were counted which shows that much space is given to a cultivation of that crop. These facts show that in these counties the chickens have ample opportunity to find places where nests may pass the incubating season unmolested. In one fence row a quarter of a mile in length, three old nests with egg shells were found.

Of the two counties in which most work was done, Coles is in the black prairie and Effingham in the clay. There are approximately 249,600 acres of prairie land in Coles and 209,066 acres in Effingham. According to the averages given above this gives the former county 10,400 prairie chickens and the latter 59,733. Allowing Effingham as much prairie land as Coles, the average would have given her 71,680 prairie chickens, over seven times as many as the latter County.

A District Deputy Game Warden who accompanied me on most of this work assured me that much illegal hunting of prairie chickens had occurred in the southern counties. Having lived in Coles County, I know that most farmers of that region are religious in the protection of these birds there. So it is not at all a question of shooting the birds. It seems that all the evidence tends to show that it is a question of abundance of natural breeding places. It is true that the destruction of breeding places is very intimately connected with the abundance of animal forms inhabiting tillable soil and it is also true that it is a more potent factor in the abundance of other forms than is usually accorded it.

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A Field-Lesson on the Fuel-Woods of the Farm

James G. Needham

One of the first of the resources of nature to be brought into human service was fire. Lightning and other causes set wild fires going, and the savage following in their wake, found that they had done certain useful work for him. They had cut pieces of timber into lengths and shapes that were convenient to his hand. They had roasted wild roots and green fruits, and the flesh of wild animals overtaken, and had made them much more palatable. They had left piles of glowing embers beside which on a chill day he warmed himself. So he took a hint from nature, added a few sticks to the live embers, and kept the fire going. Strange that no other animal has done this simple thing! Afterwards he found out how to start a fire, by rubbing wooden sticks, later by striking flint on steel and still later by friction matches. The wonder of the savage has become commonplace.

Since cooking began, the word fireside has been synonymous with home. Fire has been the indispensable agent of many comforts, and womankind have been the keepers of it. The wildwood has furnished the fuel. In the wood there is great variety of it: fine twigs and coarse, and bark and splinters, all ready for use; and dead trees down, and green trees standing, needing cutting. Fire was the cutting agent first employed. Trees were burned down by building fires about their bases, and then by similar process they were cut in sections. It was only for long-keeping fires that such fuel

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was needed: there was always excess of kindling-stuffs available for making quick fires.

All wood will burn and give forth heat, but one who knows woods will not use all kinds: it is only the degenerate

FIG. 43. Western yellow pine dismantled and ignited by lightning (U. S. Bureau of Forestry.)

modern, who will do that: who will go to the telephone and order a cord of wood without further specifications. Heavy, close grained, hard woods as a rule burn more slowly and yield more heat than the lighter more open-textured soft woods. Combustible resins vary the rate of burning, and the amount of heat produced: but the greatest differences in burning qualities are due to the amount of water present. A punky old log that when dry will burn like tinder will soak up water like a sponge and, becoming "water logged," will not

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burn at all. The modern, who keeps his fuels under cover, can get along without knowing about woods much that was essential to the savage.

Building a camp fire in the rain is a task that takes one back again to the point where he needs to know wood fuels as nature furnishes them. Certain trees, like the yellow birch, produce the needed kindling material. Strip the loose "curl" from the outside bark, resin-filled and water proof; shake the adherent water from it, and you can ignite it with a match. Go to the birch also or to the hemlock for dry kindling wood: the dead branches remaining on the trunks make the best of fagots, and are enclosed in waterproof bark. Splinter them and put them on the hot flame from the "birch curl", increase their size as the heat rises, and soon you have a fire that will defy a moderate rain. If you want to get much heat out of a little fire, feed it with thick strips of resinuous hemlock bark, or with pine knots.

These are special materials, the presence of which often determines camp sites; though excellent, they are not essential. Any ready-burning dry wood may be kindled if splintered fine enough. Skill in fire-making consists not alone in the selection of suitable materials. They must be gradually increased in size as the heat increases, but not fed larger than can be quickly brought to the igniting point. Air must be admitted to combustion as well as wood; and as the heated air rises, the sticks must be so placed as to admit fresh air freely below. It is easy to smother a nascent fire. The sticks must be so placed that as the centers are burned the remaining portions will be fed automatically into the coals. It is easy to so pile the fuel that a big central flame will be quickly followed by a black hollow central cavity, walled in by excellent but unavailable fuel. A well built fire does not suffer sudden relapses. The qualities of a good fire are: (1) a rapid increase to the desired size, and (2) steady burning (with no great excess of heat) thereafter.

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FIG. 44. Dan Beard's famous fire of four pine knots: *a*, the preparation of one of the knots; *b*, the placing and igniting of them.

Dan Beard's famous campfire of four pine knots illustrates well the principles of fire making. Each knot is cleft in tapering shavings, which, ignited at their tips, gradually increase in size as the fire runs along them and the heat increases. They are set with thick ends upward and bases outspread, admitting air freely below. They are leaned against one another, and as they burn, they automatically come closer together.

The "top fire" of the Adirondack woodsmen illustrates excellently a long-keeping fire, that is based on a discriminating knowledge of fuel values. Figure 45a illustrates its construction at the start. Two water-logged chunks of hemlock that will not burn out, serve as "andirons" to hold up the sides and insure a continuous air supply from below. A smooth platform of freshly cut yellow birch poles is laid upon these. The yellow birch, even when green, has good fire keeping qualities. Hickory would serve the purpose. An ordinary fire is then built upon the top of the birch platform by means of kindling and fagots and

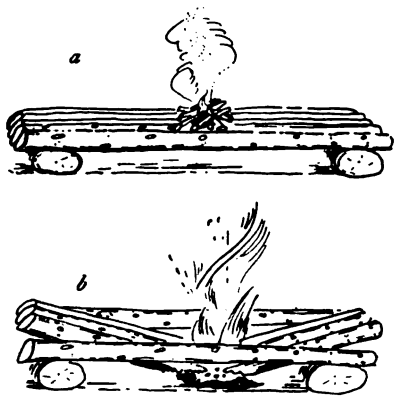

FIG. 45. A woodsman's long-keeping "top-fire": *a*, beginning; *b*, well under way and ready for the rolling on of the side logs.

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rungs. As live coals form, the birch poles are burned through in the middle and fall in the midst of the coals and keep on burning. The extension of the fire outward is promoted by the upward inclination of their ends. A fire of this sort, properly begun, will continue to burn steadily through the greater part of the night, without excess of heat at the beginning, and without any further attention.

A woodsman knows there are certain fuels that burn well enough that must be avoided in camp: hemlock, for example, whose confined combustion-gases explode noisily, throwing live coals in all directions. One does not want his blankets burned full of holes. And even the householder who sits by his fireplace should know that there are woods like hickory and sassafras that burn with the fragrance of incense: woods like sumach that crackle and sing: woods, like knotty pitch pine, that flare and sputter and run low, and give off flames with tints as variable and as delightful as their shapes are fantastic. One who has burned knots observantly, will never order from his fuel dealer for an open fire "clear straight-grained wood," even though he have to split it himself.

It has been the wasteful American way to pile and burn the tree tops in the woods for riddance of them, and then to split kindling at home. With a wood famine at hand we ought to be less wasteful. Half the wood produced by a tree is in its branches. Some trees hold their branches long after they are killed by overhead shading. Others with less resistant bark, drop them early and in an advanced stage of decay. Fagots gathered in the forest are, therefore, quite as different in their burning qualities as is the wood of the trunks. It should be the object of the following study to learn at first hand, what these differences are.

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Study of the Fuel-woods of the Farm

The work of this study should be conducted in the wood-lot or in a bit of native forest, where there is a great variety of woody plants, big and little, living and dead. There should be found a few trees fallen and rotting; a few, broken by storms or shattered by lightning; some, diseased by fungi or eaten by beetles or ants: dead snags, tunneled by woodpeckers: old boles tattooed by sapsuckers: sprouting stumps, and scattered weaklings smothered by lustier competitors: In short, the usual wildwood mixture of sorts and conditions.

The tools needed will be a pocket knife and a hatchet or a brick hammer to split and splinter with. The modern convenience of matches will be allowed to all. A few axes and cross-cut saws may be taken for common use. To save the axes from certain abuse, chopping blocks should be provided in advance.

The program of work will consist of: (1) a gathering of fuel stuffs from the wood-lot; and (2) a testing of them in firemaking.

1. The wood-lot should first be explored for firemaking materials. Quick-kindling stuff will be wanted chiefly for this brief exercise. These are of several categories (a) "dead and down" stuffs in the woods, the result of nature's pruning and thinning. Nature has placed good firemaking materials handy. As you collect observe what kinds of trees hold their dead branches longest and preserve them most free from decay. If there are shattered trunks within reach, knock off the shattered ends and try them for kindling. Compare splintering with chopping as a means of preparing kindling stuff from dry softwood.

(b) Resinous stuffs, such as the "curl" of the outer bark of the yellow birch, the bark strips from hemlock and other conifers, pine knots from rotted logs, etc. These will be the

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more needed in the rain. If there be many kinds of materials available some sort of division of labor may be arranged for the collecting of it.

2. The materials gathered should be carried out to an open space on the lee side of the woods, and tried out in fire-making. Let the fires be so arranged as to secure a minimum of inconvenience from smoke. Each student should make a small fire (not over 18 inches in diameter) using one kind of material only. Let those more experienced at fire making try more difficult materials,—say green elm, for a climax. Let each effort result in a fire and not a smudge: It should catch quickly and burn up steadily and clearly with little smoke. To this end materials should be selected of proper kind and proper size for ready ignition, must be so arranged as to admit air below, must "feed" inward as the center burns out and must not be increased in size faster than the increasing heat warrants.

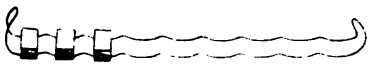

FIG. 46. A simple rack of bent wire suitable for the block testing outlined in this study.

With the individual fires burning steadily let observations be made on the readiness of ignition of other woods, green and dead, wet and dry, sound and punk. Different kinds of bark will show interesting differences in readiness of ignition.

Demonstrations: At a common fire of larger size a number of demonstrations may be made.

1. The long-burning qualities of different kinds of wood may be roughly shown by placing pieces cut to like size and form on a wire rack such as is shown in fig. 46, setting the rack upon a broad uniform bed of coals, and noting the time at which each piece is completely consumed.

2. The fire holding qualities of the same kinds of wood may be shown by like treatment of a similar lot up to the point of their complete ignition—then removing them from the fire

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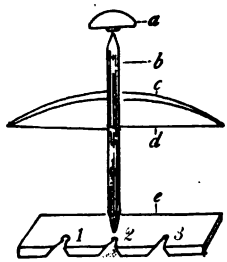

FIG. 47. Rubbing sticks for fire making: *a*, drill-socket, to which pressure is applied with the left hand (a pine knot with a shallow hole in it will do for this); *b*, the drill, an octagonal hardwood stick about fifteen inches long; the top should work smoothly in the drill socket; *c*, inelastic bow for rotating drill. It is moved horizontally back and forth with the right hand; its cord, *d*, is a leather thong with enough slack to tightly encircle the drill once; *e*, fire board of dry balsam fir, or of cottonwood root, or even of bass wood. Observe how the notches are cut with sides flaring downward, a little pit to receive the point of the fire drill is at the apex of each one; *1* is a used-out notch: *2* is yet in use; *3* is a new unused notch: the rotating of the drill with pressure from above rubs off a brownish wood powder which falls beneath the notch and smokes, and then, with gentle fanning, ignites. A dry piece of punk should be placed beneath the notch to catch it, and some fine tinder (such as may be readily made by scraping fine, dry cedar wood) should be added to catch the first flames.

and timing the disappearance first of flame, and then of red glow.

3. The burning quality of the same kind of wood in different conditions, green and dead, sapwood and heartwood; dead wood wet and dry, sound and punk; pieces from knot and from straight grained portions, etc., may be tested as in paragraph I.

4. Ancient methods of starting a fire may be demonstrated in the intervals while waiting for the pieces used in 1, 2, and 3 to burn out. With the apparatus shown in fig. 47 anyone can start a fire by friction of one piece of wood upon another and carefully nursing the first resulting spark. Flint and steel and tinder may also be tried.

5. Some interesting peculiarities of certain woods may be shown at a common fire:

(a) By having green chunks, burning at one end the liquids in the wood may be made visible. Green elm will exude water at the other end; red maple will froth; hickory will exude a very limited quantity of delicious "hickory honey."

(b) By burning pieces of chestnut, sumach, etc., the crackling of woods may be demonstrated: also the ember throwing habit of hemlock. A shower of sparks may be had by throwing on green and leafy boughs of hemlock and balsam.

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The record of this study will consist in:

1. An annotated list of the kindling woods found, with notes on their occurrence, natural characters, and burning qualities. Names will be furnished by instructors if needed.
2. A sketch showing your own preferred construction of a fire, with pieces properly graded in size for ready ignition, and properly placed for admission of air.
3. A brief statement of the results of the demonstrations made at the common fire.

Physical Nature-Study for the Elementary School

WM. T. SKILLING

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CHAPTER I

For a number of years courses given in the first year of the high school under the name of General Science or Introduction to Science have found great favor among educators and have been popular with pupils of the ninth grade. In these classes the subject matter is drawn, supposedly, from all branches of science, and the treatment among the wisest teachers is from the nature-study point of view rather than from the view point of science.

It is in this ninth year work that the child receives his first introduction to that body of facts and phenomena which are at the basis of the inorganic sciences. The nature-study of the first eight grades seldom contains anything but biological material. Beginning usually with lessons upon seeds and their germination, studied in connection with the school garden, then going on with animal life, such topics as insects, birds, pond life and household pets are made the subject of the nature lessons. Following this perhaps a study of trees and forestry is taken up after which a course in physiology rounds out the subject in the eighth year.

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If this is all, we send the pupils out with a one-sided view of nature, and those who take no science in the high school will always remain ignorant of many of the fundamental facts and processes of nature, a knowledge of which adds so much to the ethical appreciation and social efficiency of the student.

There is no reason (in the nature of the child at least) why a course may not be given which shall be introductory to the physical or inorganic sciences. That such a course is not oftener given is usually due to the fact that the teacher does not feel competent to discuss this subject matter and devise the little experiments necessary for demonstration. Experience has proved that children of the upper grammar grades take a more vital interest in the processes of inorganic nature than they do in the old-fashioned "object lesson" or in work which is exclusively biological. The difficulty of adapting material drawn from the sciences of physics, chemistry, physical geography, and astronomy, is considered so great by teachers that they are tempted to content themselves with the more objective material supplied by botany and zoology. A study of flowers and butterflies may suffice in the primary grades, but when the child's "what" changes to "why," we must put him into contact with some of the easily demonstrated laws of nature and let him feel that he is coming into a knowledge of the forces about him.

The work of this course should not be considered an addition to an already crowded curriculum, but as a substitute for an over abundance of biological nature-study. There is a gain, however, in labeling this year's work "Introduction to Science" or some such phrase. A new name, to pupils who feel that they are outgrowing "nature-study," will give new interest to the work. In like manner the name "agriculture" is to be preferred as a title for the school garden operations of the upper grades.

While it will not be possible within the limits of one or two brief articles to thoroughly discuss such a course, an attempt will be made to outline the work and to give such illustrative material as may be possible to suggest rather than to fully describe the work possible in physical nature-study.

The sciences contributing most to this division of nature-study are physics, chemistry, meteorology and astronomy. Following is an outline of subject matter which is susceptible of being put into form intelligible and interesting to children:

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1. The Air.
   The barometer—Gases in the air.
2. Capillarity and solvent action of water.
3. Heat and cold.
   How produced and transferred—wind—keeping heat in or out.
   Freezing and thawing,—Artificial ice.
4. A study of Machinery.
   The lever, pulleys, cog wheels, belt and belt wheel, inclined plane, screw, windlass.
5. Light.
   Sources, speed, reflection, diffusion, refraction, color, images (camera, etc.).
6. Sound.
   Vibrations—how sound travels—the speaking tube—the megaphone—speed of sound—echo.
7. Magnetism.
8. Electricity.
   The bell—the push button—the telegraph—the electric light—frictional electricity—discussion of other appliances.
9. Astronomy.
   The solar system—the sun—day and night—differences in temperature in different zones—the planets—the moon—eclipses of sun and moon—the tides—the stars—the constellations.

A few suggestions regarding the development of certain of the above topics will help to point out a method by which all can be treated. A cardinal principle throughout should be the avoidance of everything technical or abstruse, either in phraseology or subject matter. Highly scientific generalizations, such for example as the molecular theory or the theory of ether have no place in nature-study. Simple laws and principles such as those governing the operation of machinery ought to be given, but these should be put into concrete form using simple demonstrations.

In the study of air the first object to achieve may well be to establish in the minds of pupils the *reality* of this substance which makes so little appeal to the senses. The use of a fan, a pop gun, a bicycle pump, an inverted bottle of water and a wet leather disk for "suction" on a flat surface demonstrates its existence, and a

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reference to liquid air proves that it is a material substance with weight and so forth.

Fig. 1

The weight and pressure of air form the subject for discussion which may lead as far into the realm of meteorology as the teacher's judgment shall dictate. A barometer should certainly be used here and the effects of change of weather and of differences in elevation observed. A home-made one consisting of a glass tube filled with mercury and inverted in a small dish serves the purpose admirably. Fig. 1.

In the study of machinery the objective point should be to make plain the advantage to be gained either in speed or in power by the use of the simple machines shown in Fig. 2. Methods of demonstrating these machines are suggested in Fig. 3.

Fig. 2.

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Sound is one of the most useful topics of physical science for use in nature-study. An excellent somometer is made by fastening a wire to a door hinge and passing the other end around the knob. Musical instruments such as the violin, brought by a pupil, also illustrates laws of musical sound.

Emphasis should be laid upon experiments tending to prove that all sounds are produced by vibration.

Transmission of sound, its speed and so forth, should receive attention and be demonstrated by such methods as those suggested by fig. 5.

Doubtless the most attractive nature-study especially to boys is that chosen from the field of electricity and magnetism. There is a good deal of ground which may be covered without making the work too technical but a mention here of one or two topics for discussion is all that space will permit.

Electro-magnetism, being the basis of most of our electrical appliances, should be demonstrated. A large nail or small bolt wrapped a hundred or more times with a few cents worth of about No. 25 magnet wire purchased at an electrical store will, when attached to a dry cell, become a powerful magnet.

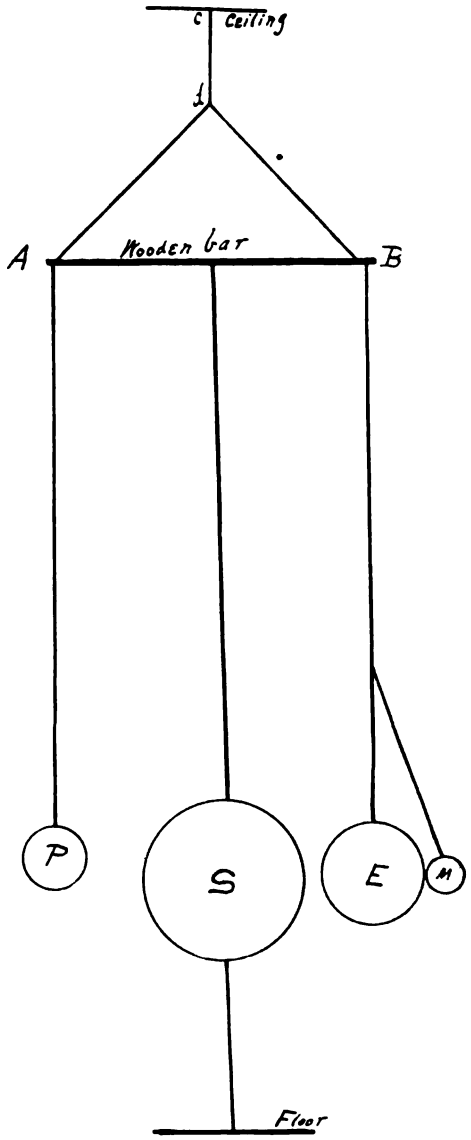

Fig. 3.

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Fig. 4.

Fig. 7

Fig. 5.

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A very efficient telegraph instrument may be made by any boy from the diagram shown in figure 7. The electro-magnet above described is mounted as shown in a hole made in a board. Above it is suspended by a rubber band a nail held close to the magnet by the brad, d (Fig. 6). The other end of the nail is supported on brad, b. The sender is made of a nail (or copper wire) *m n* held up

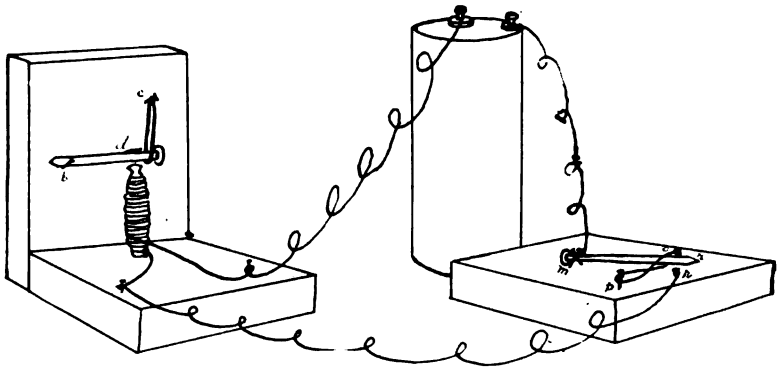

Fig. 6.

at one end by a rubber band *o p* so that the gap may be closed by pressing the nail down on the brass tack *r*.

Batteries discarded by automobile owners and garages can easily be obtained by the children without cost, and are sufficiently strong for such work.

A good test of the value of nature-study is the amount of personal effort which pupils are willing to make.

The Glass "Snake"

J. T. Buchholz

A very common reptile of the South is a legless lizard *Ophiosaurus ventralis* commonly called the glass "snake," or sometimes the joint "snake." When crawling through the grass it looks very much like a serpent, and only a close examination will reveal the fact that it is a lizard without legs. It lives in grassy meadows and burrows in the ground, depending for locomotion upon its ability to twist itself through the grass in a gliding, zigzag fashion. When placed upon a smooth surface like the floor, it is quite help-

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less and almost unable to travel in spite of its most active efforts, for its body is perfectly smooth and its ventral surface is not equipped with the scutes with which a snake is provided. Its lack of legs is an advantage in crawling through the grass, but would prove a serious handicap if it lived on the bare ground.

The glass "snake" may be distinguished from a real snake by its well-developed eyelids and its external ear openings, neither of which a serpent possesses. Its body is covered with smooth scales which give it a glossy appearance. In color it is gray, spotted and

The Glass "Snake." Average length about 27 inches. Photograph from life.

striped with brown and black. Its ventral surface is of a much lighter shade, and the anterior portion of its body has conspicuous folds on each side in the region containing the internal organs.

The digestive tract and all the vital organs are contained within the anterior one-third of its body, which averages about twenty-seven inches in length. In case of emergency it is possible for this "snake" to snap off its tail, the latter two-thirds of its length, without serious injury. According to a widespread tradition, which is as erroneous as the story of the "hoop snake," these parts reunite and the snake escapes unharmed.

There is no animal which has the power to reunite with any member of its body after it has been completely broken off, or torn off. However, many animals have the power to *regenerate* a lost part. Spiders, crawfish, crabs and scorpions regenerate lost legs, but these

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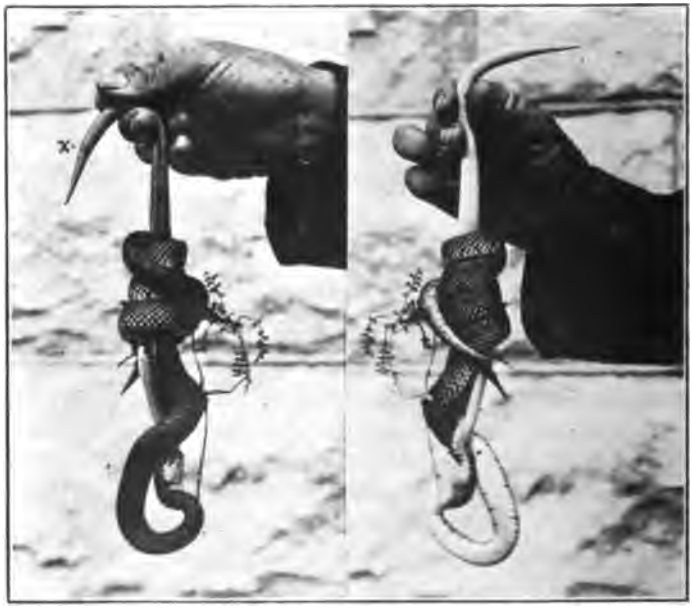
The Glass "Snake" with its tail disjointed. All the vital organs of the body are contained within the anterior one-third of its length. This portion will live on. and regenerate a new tail, but it will always be short and stubby. Photograph from life.



Two views of a King Snake in the act of swallowing a Glass "Snake" head foremost. Note that this Glass "Snake" has a short regenerated tail. The beginning of the new portion of the tail is marked by the letter X. King snakes commonly feed upon other reptiles. Photograph from life.

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new limbs are usually smaller than the regular equipment. The glass "snake," like the lizards, may lose more or less of its tail and live to regenerate a short, stubby substitute.

This power to snap off the tail is a source of protection to these animals. When pursued and overtaken by an enemy, of which the king snake is a common example, a very interesting tussle ensues, during the course of which the glass "snake" disjoints its tail, as it twists and squirms in its attempt to get away. While the enemy is busily engaged in swallowing the tail, the abbreviated body of the "snake" escapes to a place of safety, preserving its life but losing its tail. This trait is called *feeding the enemy*, though it is a very expensive form of feeding. This habit is not confined to the lizards, but may be found elsewhere in the animal kingdom.

A glass "snake" may often be seen, which has lost its tail, or one with a short regenerated tail. The photograph shows one which has regenerated the portion from the point marked X to its tip.

The glass "snake," like nearly all lizards, is not poisonous. It is commonly seen in the grass on hot days, but spends much of its time burrowing in the ground. Its food consists largely of earthworms, slugs and the soft-bodied larvae of various insects

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The Century—The Glow-worm, Henri Fabre.

Garden Magazine—Why the Black Walnut is Worth Growing, A. Rutledge.

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Nineteenth Century—Birds and the Plumage Trade, S. L. Bensusan.

Outer's Book—The American Grouse and Their Identification, R. W. Shufeldt.

Outing—Why the Leopard Needs His Spots, Chas. Livingston Bull.

Popular Science Monthly—The National Zoological Garden, R. W. Shufeldt. How the Problems of the Rural School are being met, Mary A. Grupe.

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Scribner's Magazine—The Life History of the African Rhinoceros and Hippopotamus, Th. Roosevelt. The Ascent of Denali, Hudson Stuck.

World's Work—First Up Mt. Blackburn, Dora Keen. "Chinese" Wilson, Plant Hunter.

Editorial

My Sanctuary

No architectural pile contains my shrine. My sanctuary has no marble walls nor pillars, no gilded dome, no cunningly wrought brazen doors to shut it in. There are no aisles, dim-lit through stained glass of the masters. No frescoed nave is there, no surpliced choir, no tonsured priest, no hand-made jeweled altar, no scared relic with its miraculous power.

My sanctuary lies secluded deep in the autumn woods. The spire of a mighty pine, sole survivor in the region of a glorious race, marks the spot. It wears its plumed head high above scarlet maples and yellow gold of fading birch. Gray, lichen-tinted trunks uphold a canopy of glowing color. Here amid these massive pillars is a rocky amphitheater girt about with granite walls. What titanic blow hollowed out this rocky dell? Now the uncouth force is shielded by a wealth of delicate plants that hide the rocks and cover up their scars. Parmelias and red topped Cladonias with hosts of other lichens have smoothed the rough rock edges. Polypody ferns and spleenwort are growing in the crevices and the evergreen wood fern hangs out its great fronds from the deeper earth-filled hollows. Here on the level floor cinnamon ferns rear their clustered leaves and the thick moss raises a host of brave hairy capped heads.

Into the brooding quiet of this retreat I have stumbled on my ramble. The exquisite beauty of the place charms me. Incense from the sacrificial leaves of autumn trees fills the air. A flock of clear toned white throats voice my yearnings. Scant intimation here of the travail of the centuries. Peace prevails. The fern fronds quiver with the shedding of their spores. The pine, yonder, rears its stately crown in pride of achievement which I feel if it may not. The chickadee, chasing up its trunk, is playful with the

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joy of living. I, too, thrill with the pulse of being. I, only, comprehend the eternity long process, wide as the universe, that has operated to produce all this.

> "I am the acme of things accomplished, and I am an encloser of things to be.
> Immense have been the preparations for me.
> Faithful and friendly the arms that have helped me.
> All forces have been steadily employed to complete and delight me.
> Now on this spot I stand with my robust soul."

May no low-born, clinging remnants of my animal past impede me. May I, conscious of the mighty onward movement of the ages, consciously allign myself, my life, with it. May I, each day, with smiling face, willingly assume the daily tasks, striving nobly to add my small quota to this increasing progress. Like a mighty battle-tide the evolutionary movement marches on sweeping into oblivion or disgrace men and nations that oppose it. I, then, will banish craven cowardice and courageously march with the advancing cohorts, struggling ever, with firm faith that the growing cravings of my soul are at once the revelations of the kindly spirit of the universe and prophesies of their achievement.

News Notes

Edward F. Bigelow, Sound Beach, Conn., is announcing some new lectures for Teachers' Institutes. His circular will be sent on request.

The members of the St. Louis section have shown an unusual interest in the field trips this autumn. On September 27, a party of thirty-five explored the bottom of the recently extinct Pittsburg Lake in the East St. Louis area. This afforded a fine opportunity to study flood plain plants. On October 11 a party of forty walked from Valley Park, Mo., to Fern Glen, two miles, studying talus slope plants on a south exposure on the outgoing trip and the upland plants on the return trip. An interesting feature of this portion of the trip, pointed out by Mr. Drushel, was six pieces of upland oaks, Quercus alba, Q. stellata, Q. acuminata, Q. rubra, Q. velutina, and Q. marilandica, standing within a circle of fifteen feet radius. There are twelve oaks in St. Louis Co., six upland and

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six lowland. It was also noted that in the foregoing group are found three annual species and three biennial species.

J. A. S. DRUSHEL,
St. Louis, Mo.

SOME SPARROW OBSERVATIONS

NOTE.—The following paragraph is an extract from a report of five written pages on observations made on a pair of sparrows, their nest, family, etc., extending over some time during the spring of 1909. The observer was a normal school student, over twenty years of age. It is improbable and a like report from a scientific student would be of interest. Her sketch of the behavior of the sparrows seems true enough to life.

"One day the boldest one of the nestlings sat on one of the slats of the shutter [behind which the nest had been built] and tumbled off. It fell nine feet. When the mother bird discovered the young bird she flew around the house chirping loudly. The father was the next on the scene, and he also took up the cry and before a minute had gone by there seemed to be an army of sparrows around, all were chirping wildly. At last the mother flew away and came back with a straw in its bill. She placed this before the young bird, and mother and father began chirping together; each took hold of the straw at the ends. The young sparrow caught the straw in its bill. Four other sparrows joined on the ends. Three at each end making seven sparrows in all counting the one that had tumbled down.) They all flew up to the window holding on to the straw, the young bird assisted [ing?] now and then on the journey, while all the other birds in the neighborhood seemed to fly about and call to them to keep up courage. The window ledge reached, the young bird crept back to the nest while the other birds celebrated ——."

I am also enclosing a nature observation made by a small boy in last year's third grade (I think) on sparrows nesting under our veranda. I can vouch for its truthfulness. He is a very keen observer.—C. H. ROBISON.

I found a sparrow nest on the 10th of July. It had four young birds in it. On the 19 of July I went to see the nest. As I was looking at them they all flew out on the ground. The mother bird pick [ed] up one of the little birds by the neck and flew away with it just as a cat takes her kitten. And the father bird did the same with another one. The other two flew on the stupe [stoop] where the mother bird could not find them.

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C. F. Hodge, author of the well known "Nature-Study and Life," has accepted a chair of Zoology at the University of Oregon. He is to be congratulated in throwing in his lot with this eminently progressive North West. He leaves many friends at Clark University, Worcester, Mass., with which institution he has been connected many years.

Edwin H. Scott of the State Normal School, Milledgeville, Ga., had charge of the agriculture in the Virginia Summer School this last year. He has also been conducting some interesting work on chickens with his Normal Students which work is being reflected in the grades as these students go out into the community.

Teachers College Record for May contains the curriculum of the Horace Mann School including the outlines for Nature-Study. The Speyer School curriculum (50c) was published by Teachers' College this past summer also.

THE REVIEW omitted, unintentionally, reference in earlier issues to the death of O. W. Mitchell of the Normal School at Milwaukee, Wis., which occurred last summer. Mr. Mitchell was an enthusiastic bird student, an inspiring teacher and a man honored and esteemed by a host of friends.

Jefferson Butler, President of the Michigan Audubon Society, was killed by an automobile in Detroit, his home city, Oct. 23d. During the year just passed he had given sixty-eight lectures on Nature-Study, largely on Birds, in the Schools of Michigan, taking time from his law practice to donate his services in the interests of a wider love for nature.

Here are some good Government Bulletins:

Readjustment of the Rural High School to the Needs of the Community. Brown. Ed. Bul. No. 20. 1912.

Course of Study for Rural School Teachers. Mutchler and Craig. Ed. Bul. No. 1. 1912.

Training Courses for Rural Teachers. Monahan and Wright. Ed. Bul. 2. 1913.

Agricultural Instruction in the High Schools. Robison and Jenks. Ed. Bul. No. 6. 1913.

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Distribution and Migration of N. A. Herons and their Allies. Cooke. Biol. Survey Bul. 45. 1913.

The Water Requirement of Plants. Briggs & Shartz. Bureau of Plant Industry. Bul. 285. 1913.

Fall Manual of Practice in Economic Zoology. H. A. Gossard. Ohio Ag. Exp. Sta. Wooster, Ohio. Bul. 233.

Grant Smith is now the member of the Council of the American Nature-Study Society in place of J. M. Shepherd.

Book Review

Illustrated Flora of the Northern U. S. and Canada, Britton and Brown, three volumes, XXVIII plus 2051 pages, second edition, Chas. Scribner's Lons. Price $11.00.

All students of nature-study are familiar with this book which has long been a standard for plant descriptions. This second edition is in many particulars an improvemnent over the first edition. The plants included are the Pteridophytes and the Spermatophytes. The thing which makes these volumes particularly valuable to the nature student is the fact that every plant is illustrated with line drawings which make it fairly easy for one who is not familiar with the technology of botany to follow understandingly the descriptions. The books are provided with keys by which one may determine any plant. While at the outset it seems a little difficult to use the books unless you are a botanist, you shortly come to find them invaluable, and because of their accuracy and the explicit distinctions, they soon supersede in use the popular books on plant determinations, such as, How to Know the Wild Flowers; How to Know the Ferns, etc., which are written distinctly to aid the uninitiated. Certainly, no school library is complete without these volumes, and any individual who is interested in the higher plants will possess them with delight, even if he must forego half a dozen other nature books to obtain them. One is tempted to deal in superlatives when you turn the pages of these volumes,—the cuts, typography and subject matter are all so superior.

There is far less difference in the scientific names used for the plants now between this second edition and the recent edition of Gray's Manual, than there was between the first edition and the

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old Gray. This is a satisfaction also, not only because it is less confusing to the would-be student, but also because it is evidence that at last systematists are agreed upon some principles of nomenclature and a rule of priority, so that we may hope in time to have agreement in all texts in the scientific naming.

Michigan Bird Life, Walter B. Barrows, pp. xiv + 822. Special Bulletin of the Department of Zoology and Physiology, Michigan Agricultural College, published by the College.

A History of the Game Birds, Wild Fowl and Shore Birds of Massachusetts and Adjacent States, Edward H. Forbush. Pp. x + 622. Issued by the Massachusetts State Board of Agriculture.

Every bird enthusiast will appreciate these two sumptuous bird books. Professor Barrows has long been known because of his bird studies. He has for years been identified with every effort to conserve the bird life of Michigan and no one is more familiar with the birds of this state, nor better able to write accurately and interestingly. The bulletin covers all birds known to occur in the state. Under each bird there are given a list of synonyms, both a popular and technical description, discussion of the range, habits, nest and eggs and extensive notes on local peculiarities both from Professor Barrow's personal observations and those of his numerous correspondents in the state extending over a period of many years. There are also good keys to the species under each group, and keys to the families, genera, etc.

Mr. Forbush's volume is a companion to a previous one from the same source. *Useful Birds and their Protection.* After a brief introduction (38 pages) Part I is devoted to "A History of the Birds now Hunted for Food or Sport in Massachusetts or Adjacent States. 360 pages. Part II deals with these birds formerly hunted now extinct (4 species) or extirpated (4 species). Part III, 112 pages is on "The Conservation of Game Birds, Wild Fowl and Shore Birds."

Mr. Forbush is State Ornithologist of Massachusetts, a keen observer, an enthusiastic bird student and a writer of repute. Part III is perhaps the best part of the book, not because the other parts are not excellent but because there has seldom if ever been put up a stronger plea for bird protection both in facts cited and method of presentation.

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Harper's Guide to the Wild Flowers, Mrs. Caroline A. Creevey. 555 pages. $1.75.

The book is based on the new (7th edition) of Gray's Manual. There are no keys for identification but the flowers are grouped according to color. Then lists are given under various habitats, swamps, river banks, wet meadows, etc. Finally a "Flower Calender" gives the dates when the blooms may be expected. There are many illustrations in color, and numerous ink sketches. The book will be a valuable companion to Gray's Manual, but would hardly be a substitute for it. In the attempt to avoid the technical keys the student is involved in greater difficulty. Imagine trying to distinguish the numerous asters or goldenrods by means of difference in color, habitat and date of bloom. Keys for such groups as these the members of which can not readily be separated by the method of identification adopted would enhance the value of the book greatly.

Health in Home and Town, Bertha Millard Brown, pp. vi + 312, D. C. Heath & Co., $.60.

This book is intended as a sequel to the author's earlier book, "Good Health for Girls and Boys." In the first book of the series personal hygiene is treated and in this later one matters of sanitation are taken up. The book might well serve as a sort of compendium to accompany the study of civics in the upper grades, but we scarcely see its adaptability to class work in hygiene. A large part of its topics deal with matters that the pupil in the grades is impotent to control and upon which it is futile to try to interest him. Written in a style adapted to a cyclopedia for children, it lacks in attractiveness and inspirational power. Moreover, the statements are not all in accordance with modern findings. For example, carbon dioxide is spoken of as a poisonous gas, and the lungs are said to purify the blood. Alcohol is referred to as a stimulant. However, the book is well printed and bound, and its illustrations are particularly well chosen and attractive.

F. M. G.

The Living Plant, Wm. F. Ganong, pages XIV plus 478, Henry Holt & Co., price $3.50.

Professor Genong has long been known as an eminent American plant physiologist, and as the title of the book indicates, this is a study of botany from the standpoint of the plant's activities.

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There are successive chapters on photosynthesis, the morphology and ecology of leaves and stems, respiration, metabolism, protoplasm, roots and absorption, irritability, reproduction, pollination, growth, etc. Most of the subject matter deals with the higher plants, though in such chapters as those on reproduction, growth, etc., some attention is paid to the lower forms.

The book is a very readable one, clear in its style and emphatic in its statements, and even the lay reader must feel that he has a fairly clear notion of the life activities of the plant on its completion. One is rather disappointed to find so little space given to plant breeding and the laws of inheritance, which seems to occupy a relatively important place in current biological literature. The book is quite up to the standard already set by other volumes in this American Nature series that Henry Holt & Company are getting out.

Bird Study Note Book by Clara Cozard Keezel, single copies 27 cents postpaid, discount for quantities.

This book is the outgrowth of Mrs. Keezel's teaching and is characterized by directness and simplicity. There is room in it for the common name of the bird, the date of its arrival, whether it is migratory or resident, a note on its conspicuous colors and markings, its principal food, the kind of nest which it builds and the location of the nest.

The pledge on the first page, directly above the name of the pupil is perhaps one of the most important features of the book. The pledge is the one suggested by Professor Clifton Hodge: "I promise to do all I can for our native birds, by treating them with kindness and providing them with food, water, and homes." On the last page there are very practical suggestions for bird study. In fact, the whole book bears the stamp of practical experience.

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